

Figure 1A

(SEQ ID NO:1 - nucleotide sequence and SEQ ID NO:2 - amino acid sequence)

AEPII1a Archeal Endoglucanase Sequence

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          9          18          27          36          45          54
5'  ATG ATA AAC GTT GCA ACG GGA GAG GAG ACC CCA ATA CAC CTC TTT GGA GTC AAC
    -----
    Met Ile Asn Val Ala Thr Gly Glu Glu Thr Pro Ile His Leu Phe Gly Val Asn

          63          72          81          90          99          108
    TGG TTC GGC TTT GAG ACA CCG AAC TAC GTT GTT CAC GGC CTA TGG AGT AGG AAC
    -----
    Trp Phe Gly Phe Glu Thr Pro Asn Tyr Val Val His Gly Leu Trp Ser Arg Asn

          117          126          135          144          153          162
    TGG GAG GAC ATG CTC CTC CAG ATC AAG AGC CTT GGC TTC AAT GCG ATA AGG CTT
    -----
    Trp Glu Asp Met Leu Leu Gln Ile Lys Ser Leu Gly Phe Asn Ala Ile Arg Leu

          171          180          189          198          207          216
    CCC TTC TGT ACC CAG TCA GTA AAA CCG GGG ACG ATG CCA ACG GCG ATT GAC TAC
    -----
    Pro Phe Cys Thr Gln Ser Val Lys Pro Gly Thr Met Pro Thr Ala Ile Asp Tyr

          225          234          243          252          261          270
    GCC AAG AAC CCA GAC CTC CAG GGT CTT GAC AGC GTC CAG ATA ATG GAG AAA ATA
    -----
    Ala Lys Asn Pro Asp Leu Gln Gly Leu Asp Ser Val Gln Ile Met Glu Lys Ile

          279          288          297          306          315          324
    ATC AAG AAG GCT GGA GAC CTG GGC ATA TTC GTG CTC CTC GAC TAC CAC AGA ATA
    -----
    Ile Lys Lys Ala Gly Asp Leu Gly Ile Phe Val Leu Leu Asp Tyr His Arg Ile

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333	342	351	360	369	378
GGA TGC AAC TTC ATA GAA CCC CTA TGG TAC ACC GAC AGC TTC TCG GAG CAG GAC					
---	---	---	---	---	---
Gly Cys Asn Phe Ile Glu Pro Leu Trp Tyr Thr Asp Ser Phe Ser Glu Gln Asp					

387	396	405	414	423	432
TAC ATA AAC ACC TGG GTT GAA GTC GCC CAG AGG TTC GGC AAG TAC TGG AAC GTT					
---	---	---	---	---	---
Tyr Ile Asn Thr Trp Val Glu Val Ala Gln Arg Phe Gly Lys Tyr Trp Asn Val					

441	450	459	468	477	486
ATC GGC GCG GAC CTG AAG AAC GAA CCC CAC AGC TCA AGC CCC GCA CCT GCC GCC					
---	---	---	---	---	---
Ile Gly Ala Asp Leu Lys Asn Glu Pro His Ser Ser Ser Pro Ala Pro Ala Ala					

495	504	513	522	531	540
TAC ACT GAC GGA AGT GGG GCC ACG TGG GGA ATG GGC AAC AAC GCC ACC GAC TGG					
---	---	---	---	---	---
Tyr Thr Asp Gly Ser Gly Ala Thr Trp Gly Met Gly Asn Asn Ala Thr Asp Trp					

549	558	567	576	585	594
AAC CTG GCG GCT GAG AGG ATA GGA AGG GCA ATT CTG GAG GTT GCC CCA CAA TGG					
---	---	---	---	---	---
Asn Leu Ala Ala Glu Arg Ile Gly Arg Ala Ile Leu Glu Val Ala Pro Gln Trp					

603	612	621	630	639	648
GTT ATA TTT GTT GAG GGA ACC CAG TTC ACC ACC CCC GAG ATA GAC GGT AGG TAC					
---	---	---	---	---	---
Val Ile Phe Val Glu Gly Thr Gln Phe Thr Thr Pro Glu Ile Asp Gly Arg Tyr					

657	666	675	684	693	702
AAG TGG GGC CAC AAC GCC TGG TGG GGC GGA AAC CTT ATG GGT GTT AGG AAG TAC					
---	---	---	---	---	---
Lys Trp Gly His Asn Ala Trp Trp Gly Gly Asn Leu Met Gly Val Arg Lys Tyr					

711 720 729 738 747 756
CCA GTT AAC CTG CCC AGG GAC AAG GTT GTT TAC AGC CCC CAA GTT TAC GGT TCA

Pro Val Asn Leu Pro Arg Asp Lys Val Val Tyr Ser Pro Gln Val Tyr Gly Ser

765 774 783 792 801 810
GAA GTT TAC GAC CAG CCC TAC TTT GAC CCC GGT GAG GGG TTC CCC GAC AAC CTC

Glu Val Tyr Asp Gln Pro Tyr Phe Asp Pro Gly Glu Gly Phe Pro Asp Asn Leu

819 828 837 846 855 864
CCC GAA ATA TGG TAC CAC CAC TTC GGC TAC GTA AAG CTT GAT CTC GGT TAC CCT

Pro Glu Ile Trp Tyr His His Phe Gly Tyr Val Lys Leu Asp Leu Gly Tyr Pro

873 882 891 900 909 918
GTT GTT ATA GGT GAG TTC GGA GGC AAG TAC GGC CAT GGG GGA GAC CCG AGG GAT

Val Val Ile Gly Glu Phe Gly Gly Lys Tyr Gly His Gly Gly Asp Pro Arg Asp

927 936 945 954 963 972
GTC ACT TGG CAG AAC AAG ATA ATA GAC TGG ATG ATC CAG AAC AAA TTC TGT GAC

Val Thr Trp Gln Asn Lys Ile Ile Asp Trp Met Ile Gln Asn Lys Phe Cys Asp

981 990 999 1008 1017 1026
TTC TTC TAC TGG AGC TGG AAC CCA AAC AGC GGT GAC ACC GGT GGA ATT CTG AAG

Phe Phe Tyr Trp Ser Trp Asn Pro Asn Ser Gly Asp Thr Gly Gly Ile Leu Lys

1035 1044 1053 1062 1071 1080
GAT GAC TGG ACG ACA ATA TGG GAG GAC AAG TAC AAC AAC CTG AAG AGG CTC ATG

Asp Asp Trp Thr Thr Ile Trp Glu Asp Lys Tyr Asn Asn Leu Lys Arg Leu Met

1089	1098	1107	1116	1125	1134
GAC AGC TGT TCT GGA AAC GCC ACT GCC CCG TCC GTC CCC ACG ACA ACT ACA ACA					
----	----	----	----	----	----
Asp Ser Cys Ser Gly Asn Ala Thr Ala Pro Ser Val Pro Thr Thr Thr Thr Thr					

1143	1152	1161	1170	1179	1188
ACA AGC ACA CCG CCA ACG ACC ACA ACG ACT ACA ACA TCC ACT CCA ACG ACC ACT					
----	----	----	----	----	----
Thr Ser Thr Pro Pro Thr Thr Thr Thr Thr Thr Thr Ser Thr Pro Thr Thr Thr					

1197	1206	1215	1224	1233	1242
ACC CAG ACC CCG ACC ACC ACT ACT CCA ACT ACG ACA ACC ACC ACG ACC ACA ACT					
----	----	----	----	----	----
Thr Gln Thr Pro Thr Thr Thr Thr Pro Thr Thr Thr Thr Thr Thr Thr Thr Thr					
1251	1260	1269	1278	1287	1296
CCT TCA AAT AAC GTC CCA TTT GAA ATT GTG AAC GTT CTC CCG ACT AGC TCC CAG					
----	----	----	----	----	----
Pro Ser Asn Asn Val Pro Phe Glu Ile Val Asn Val Leu Pro Thr Ser Ser Gln					

1305	1314	1323	1332	1341	1350
TAC GAG GGA ACC AGC GTG GAG GTT GTA TGT GAT GGA ACC CAG TGT GCC TCC AGC					
----	----	----	----	----	----
Tyr Glu Gly Thr Ser Val Glu Val Val Cys Asp Gly Thr Gln Cys Ala Ser Ser					

1359	1368	1377	1386	1395	1404
GTT TGG GGA GCT CCG AAC CTC TGG GGA GTC GTT AAA ATC GGA AAC GCC ACC ATG					
----	----	----	----	----	----
Val Trp Gly Ala Pro Asn Leu Trp Gly Val Val Lys Ile Gly Asn Ala Thr Met					

1413	1422	1431	1440	1449	1458
GAC CCC AAC GTT TGG GGC TGG GAG GAC GTT TAC AAG ACT GCA CCC CAG GAC ATT					
----	----	----	----	----	----
Asp Pro Asn Val Trp Gly Trp Glu Asp Val Tyr Lys Thr Ala Pro Gln Asp Ile					

1467	1476	1485	1494	1503	1512
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GGA ACC GGC AGC ACA AAG ATG GAG ATA AGG AAC GGG GTG CTC AAG GTT ACA AAC

Gly Thr Gly Ser Thr Lys Met Glu Ile Arg Asn Gly Val Leu Lys Val Thr Asn

1521 1530 1539 1548 1557 1566
CTC TGG AAC ATC AAC ATG CAT CCG AAG TAT AAC ACA ATG GCA TAC CCG GAG GTC

Leu Trp Asn Ile Asn Met His Pro Lys Tyr Asn Thr Met Ala Tyr Pro Glu Val

1575 1584 1593 1602 1611 1620
ATA TAC GGC GCC AAG CCT TGG GGC AAC CAG CCA ATA AAC GCT CCG AAC TTC GTG

Ile Tyr Gly Ala Lys Pro Trp Gly Asn Gln Pro Ile Asn Ala Pro Asn Phe Val

1629 1638 1647 1656 1665 1674
CTC CCG ATA AAG GTC TCC CAG CTT CCG AGG ATA CTC GTT GAC ACA AAG TAC ACG

Leu Pro Ile Lys Val Ser Gln Leu Pro Arg Ile Leu Val Asp Thr Lys Tyr Thr

1683 1692 1701 1710 1719 1728
CTC GAA AAG AGC TTC CCG GGA AAC AAC TTC GCC TTT GAG GCC TGG CTC TTC AAG

Leu Glu Lys Ser Phe Pro Gly Asn Asn Phe Ala Phe Glu Ala Trp Leu Phe Lys

1737 1746 1755 1764 1773 1782
GAT GCC AAC AAC ATG AGG GCA CCA GGC CAG GGG GAC TAC GAG ATA ATG GTA CAG

Asp Ala Asn Asn Met Arg Ala Pro Gly Gln Gly Asp Tyr Glu Ile Met Val Gln

1791 1800 1809 1818 1827 1836
CTC TAC ATC GAG GGC GGC TAT CCT GCG GGC TAC GAC AAG GGG CCA GTT CTC ACC

Leu Tyr Ile Glu Gly Gly Tyr Pro Ala Gly Tyr Asp Lys Gly Pro Val Leu Thr

1845 1854 1863 1872 1881 1890
GTT GAT GTT CCG ATA ATC GTC GAT GGA AGG CTT GTA AAC CAG ACT TTT GAG CTC

6/121

 Val Asp Val Pro Ile Ile Val Asp Gly Arg Leu Val Asn Gln Thr Phe Glu Leu

1899 1908 1917 1926 1935 1944
 TAC GAC GTC ATA GCG GAT GCC GGA TGG AGG TTC TTC ACC TTC AAG CCA ACT AAG

 Tyr Asp Val Ile Ala Asp Ala Gly Trp Arg Phe Phe Thr Phe Lys Pro Thr Lys

1953 1962 1971 1980 1989 1998
 AAC TAC AAC GGC TCA GAG GTT GTG TTC GAC TAC ACC AAA TTC ATA GAA ATA GTT

 Asn Tyr Asn Gly Ser Glu Val Val Phe Asp Tyr Thr Lys Phe Ile Glu Ile Val

2007 2016 2025 2034 2043 2052
 GAC AAC TAC CTC GGC GGT GGC AGC CTC ACG AAC CAC TAC CTG ATG TCC CTG GAA

 Asp Asn Tyr Leu Gly Gly Gly Ser Leu Thr Asn His Tyr Leu Met Ser Leu Glu

2061 2070 2079 2088 2097 2106
 TTC GGT ACC GAG ATA TAC ACC AAC GGG TGC ACC TCA TTC CCA TGC ACA GTG GAC

 Phe Gly Thr Glu Ile Tyr Thr Asn Gly Cys Thr Ser Phe Pro Cys Thr Val Asp

2115 2124 2133 2142 2151 2160
 GTA AGG TGG ACC CTT GAC AAG TAC AGG TTC ATC CTG GCC CCA GGA ACA ATG GCC

 Val Arg Trp Thr Leu Asp Lys Tyr Arg Phe Ile Leu Ala Pro Gly Thr Met Ala

2169 2178 2187 2196 2205 2214
 ACT GAG GAG GCC ATG AGA GTT CTC GTC GGA GAG GTC CAG CCT CCC GCT TCC ACA

 Thr Glu Glu Ala Met Arg Val Leu Val Gly Glu Val Gln Pro Pro Ala Ser Thr

2223 2232 2241 2250 2259 2268
 ACA ACA TCG CAG ACG ACT ACT TCA ACC ACA ACC CCA ACG CCC ACT ACC ACT ACT

Thr Thr Ser Gln Thr Thr Thr Ser Thr Thr Thr Pro Thr Pro Thr Thr Thr Thr

2277 2286 2295 2304 2313 2322
ACG ACT CAG ACT TCA ACC ACC ACT ACA ACC ACC TCA CCG CCG ACA ACC ACC GCA

Thr Thr Gln Thr Ser Thr Thr Thr Thr Thr Thr Ser Pro Pro Thr Thr Thr Ala

2331 2340 2349 2358 2367 2376
CCT GCT CAG GAC GTA ATT AAG CTC AGG TAC CCG GAC GAT GGG CAG TGG CCC GAG

Pro Ala Gln Asp Val Ile Lys Leu Arg Tyr Pro Asp Asp Gly Gln Trp Pro Glu

2385 2394 2403 2412 2421 2430
GCC CCA ATT GAC AGG GAT GGA GAC GGA AAC CCA GAG TTC TAC ATA GAA ATA AAC

Ala Pro Ile Asp Arg Asp Gly Asp Gly Asn Pro Glu Phe Tyr Ile Glu Ile Asn

2439 2448 2457 2466 2475 2484
CCG TGG AAC ATA CTG AGC GCT GAA AGC TAC GCC GAG ATG ACC TAC AAC TTG AGC

Pro Trp Asn Ile Leu Ser Ala Glu Ser Tyr Ala Glu Met Thr Tyr Asn Leu Ser

2493 2502 2511 2520 2529
AGC GGG GTT CTC CAC TAC GTC CAG GCC CTG GAT AGT ATA TGA TGA 3'

Ser Gly Val Leu His Tyr Val Gln Ala Leu Asp Ser Ile *** **

Figure 1B

(SEQ ID NO:3 - nucleotide sequence and SEQ ID NO:4 - amino acid sequence)

OC9a (clone # 27GA1) Glycosidase

1

ATG CCA ACC AAT GTA TTT TTC AAC GCC CAT CAC TCG CCG GTT GGG GCG TTT

Met Pro Thr Asn Val Phe Phe Asn Ala His His Ser Pro Val Gly Ala Phe

GCC AGC TTT ACG CTA GGG TTT CCG GGA AAA AGC GGA GGA CTG GAC TTG GAA

Ala Ser Phe Thr Leu Gly Phe Pro Gly Lys Ser Gly Gly Leu Asp Leu Glu

CTT GCC CGA CCG CCA CGG CAA AAT GTC TTT ATT GGC GTT GAG TCG CCG CAT

Leu Ala Arg Pro Pro Arg Gln Asn Val Phe Ile Gly Val Glu Ser Pro His

GAG CCG GGG CTG TAT CAT ATC CTT CCA TTC GCG GAA ACA GCA GGC GAG GAT

Glu Pro Gly Leu Tyr His Ile Leu Pro Phe Ala Glu Thr Ala Gly Glu Asp

GAA AGC AAA CGA TAT GAC ATT GAA AAT CCT GAT CCG AAT CCG CAA AAA CCA

Glu Ser Lys Arg Tyr Asp Ile Glu Asn Pro Asp Pro Asn Pro Gln Lys Pro

AAC ATC CTG ATT CCA TTT GCG AAA GAG CGG ATC GAA CGC GAA TTT CGC GTT

Asn Ile Leu Ile Pro Phe Ala Lys Glu Arg Ile Glu Arg Glu Phe Arg Val

GCC ACG GAT ACA TGG AAG GCC GGG GAC TTG ACG TTG ACG ATT TAT TCA CCG

Ala Thr Asp Thr Trp Lys Ala Gly Asp Leu Thr Leu Thr Ile Tyr Ser Pro

GTG AAG GCC GTA CCA GAT CCG GAA ACG GCC TCC GAG GAA GAA CTC AAG TTG
Val Lys Ala Val Pro Asp Pro Glu Thr Ala Ser Glu Glu Glu Leu Lys Leu

GCG TTG GTT CCA GCT GTC ATT GTC GAG ATG ACG ATC GAT AAT ACG AAC GGA
Ala Leu Val Pro Ala Val Ile Val Glu Met Thr Ile Asp Asn Thr Asn Gly

ACA AGA ACA CGA CGG GCG TTT TTC GGA TTC GAA GGC ACT GAC CCG TAT ACC
Thr Arg Thr Arg Arg Ala Phe Phe Gly Phe Glu Gly Thr Asp Pro Tyr Thr

TCG ATG CGG GGG ATC GAT GAT ACA TGC CCG CAG CTG CGC GGT GTC GGT CAA
Ser Met Arg Gly Ile Asp Asp Thr Cys Pro Gln Leu Arg Gly Val Gly Gln

GGG CGG ATT TTG GGC ATA GCA TCC AAG GAT GAG GGC GTT CGT TCA GCA CTG
Gly Arg Ile Leu Gly Ile Ala Ser Lys Asp Glu Gly Val Arg Ser Ala Leu

CAT TTT AGC ATG GAG GAT ATC TTA ACG GCG ACT CTC GAA GAA AAC TGG ACG
His Phe Ser Met Glu Asp Ile Leu Thr Ala Thr Leu Glu Glu Asn Trp Thr

TTT GGG CTC GGG AAA GTC GGT GCA TTA ATT GCG GAT GTG CCG GCG GGA GAA
Phe Gly Leu Gly Lys Val Gly Ala Leu Ile Ala Asp Val Pro Ala Gly Glu

AAG AAA ACG TAT CAA TTT GCT GTT TGC TTC TAT CGT GGG GGT TGT GTG ACG
Lys Lys Thr Tyr Gln Phe Ala Val Cys Phe Tyr Arg Gly Gly Cys Val Thr

10/121

GCG GGA ATG GAT GCC TCT TAT TTT TAC ACC CGT TTC TTC CAT AAT ATC GAA

Ala Gly Met Asp Ala Ser Tyr Phe Tyr Thr Arg Phe Phe His Asn Ile Glu

GAA GTC GGT CTT TAT GCG TTA GAG CAG GCC GAG GTG TTA AAA GAG CAG GCG

Glu Val Gly Leu Tyr Ala Leu Glu Gln Ala Glu Val Leu Lys Glu Gln Ala

TTC CGT TCG AAT GAA CTC ATT GAA AAA GAA TGG CTC TCC GAT GAT CAA AAG

Phe Arg Ser Asn Glu Leu Ile Glu Lys Glu Trp Leu Ser Asp Asp Gln Lys

TTT ATG ATG GCG CAC GCG ATC CGT AGC TAC TAT GGC AAT ACA CAG CTG CTT

Phe Met Met Ala His Ala Ile Arg Ser Tyr Tyr Gly Asn Thr Gln Leu Leu

GAG CAT GAA GGA AAG CCG ATT TGG GTC GTC AAT GAA GGC GAG TAC CGG ATG

Glu His Glu Gly Lys Pro Ile Trp Val Val Asn Glu Gly Glu Tyr Arg Met

ATG AAT ACG TTT GAT CTC ACC GTC GAC CAG CTC TTT TTT GAA TTG AAA ATG

Met Asn Thr Phe Asp Leu Thr Val Asp Gln Leu Phe Phe Glu Leu Lys Met

AAT CCG TGG ACG GTG AAA AAT GTG CTT GAC TTT TAT GTC GAG CGC TAC AGC

Asn Pro Trp Thr Val Lys Asn Val Leu Asp Phe Tyr Val Glu Arg Tyr Ser

TAT GAG GAT CGT GTC CGT TTC CCA GGA GAT GAG ACG GAA TAC CCC GGC GGC

11/121

Tyr Glu Asp Arg Val Arg Phe Pro Gly Asp Glu Thr Glu Tyr Pro Gly Gly

ATC AGC TTC ACT CAC GAT ATG GGA GTC GCC AAC ACG TTC TCA CGC CCG CAT

Ile Ser Phe Thr His Asp Met Gly Val Ala Asn Thr Phe Ser Arg Pro His

TAC TCG TCA TAT GAG CTA TAC GGG ATC AGC GGC TGC TTT TCA CAT ATG ACG

Tyr Ser Ser Tyr Glu Leu Tyr Gly Ile Ser Gly Cys Phe Ser His Met Thr

CAC GAA CAG CTC GTC AAC TGG GTG CTT TGC GCA GCG GTA TAC ATC GAA CAA

His Glu Gln Leu Val Asn Trp Val Leu Cys Ala Ala Val Tyr Ile Glu Gln

ACG AAA GAC TGG GCA TGG CGC GAC CGG CGG CTT ACG ATC TTG GAA CAA TGT

Thr Lys Asp Trp Ala Trp Arg Asp Arg Arg Leu Thr Ile Leu Glu Gln Cys

CTC GAA AGC ATG GTG CGC CGC GAT CAT CCG GAT CCA GAA AAG CGG AAC GGC

Leu Glu Ser Met Val Arg Arg Asp His Pro Asp Pro Glu Lys Arg Asn Gly

GTG ATG GGG CTT GAC AGC ACC CGC ACG ATG GGT GGA GCG GAA ATC ACA ACG

Val Met Gly Leu Asp Ser Thr Arg Thr Met Gly Gly Ala Glu Ile Thr Thr

TAT GAT AGT TTG GAT GTT TCT CTT GGC CAG GCG CGC AAC AAT TTA TAT TTG

Tyr Asp Ser Leu Asp Val Ser Leu Gly Gln Ala Arg Asn Asn Leu Tyr Leu

12/121

GCA GGA AAA TGT TGG GCT GCC TAT GTG GCG CTC GAA AAG TTG TTC CGC GAT
Ala Gly Lys Cys Trp Ala Ala Tyr Val Ala Leu Glu Lys Leu Phe Arg Asp

GTC GGC AAA GAA GAA CTG GCT GCA TTG GCA AGG GAG CAG GCG GAA AAA TGC
Val Gly Lys Glu Glu Leu Ala Ala Leu Ala Arg Glu Gln Ala Glu Lys Cys

GCC GCG ACG ATT GTC AGT CAC GTG ACG GAG GAC GGG TAT ATC CCA GCC GTG
Ala Ala Thr Ile Val Ser His Val Thr Glu Asp Gly Tyr Ile Pro Ala Val

ATG GGA GAA GGA AAT GAC TCG AAA ATC ATT CCG GCT ATT GAG GGG CTT GTG
Met Gly Glu Gly Asn Asp Ser Lys Ile Ile Pro Ala Ile Glu Gly Leu Val

TTT CCT TAC TTT ACG AAC TGC CAT GAG GCG TTA AGA GAA GAC GGA CGT TTT
Phe Pro Tyr Phe Thr Asn Cys His Glu Ala Leu Arg Glu Asp Gly Arg Phe

GGA GAC TAT ATT CGT GCA CTG CGA CAA CAT TTG CAA TAT GTG TTG CGG GAA
Gly Asp Tyr Ile Arg Ala Leu Arg Gln His Leu Gln Tyr Val Leu Arg Glu

GGA ATT TAC CTA TTC CCG GAC GGG GGA TGG AAA ATT TGC CTC GAC AAG CAA
Gly Ile Tyr Leu Phe Pro Asp Gly Gly Trp Lys Ile Cys Leu Asp Lys Gln

CAA CTC GTG GTT GAG CAA AAT TTA CTT ATG CCA GTT TAT TGC CCG CCG CAT
Gln Leu Val Val Glu Gln Asn Leu Leu Met Pro Val Tyr Cys Pro Pro His

13/121

TTT AGG GTG GGA ATG GGA TGA 1958
Phe Arg Val Gly Met Gly END

Figure 1C

(SEQ ID NO:5 - nucleotide sequence and SEQ ID NO:6 - amino acid sequence)

Bankia gouldi mix (Clone # 37GP2) Glycosidase

1

ATG TTG AAA AAA CTG GCT TTA GCA GCC GGG ATC GCA GCA GCA ACA CTG GCT

Met Leu Lys Lys Leu Ala Leu Ala Ala Gly Ile Ala Ala Ala Thr Leu Ala

GCA TCC GGT TCC CAT GGG CAG ACG TTC GCG TAC GGC GAA GCT CTG CAA AAA

Ala Ser Gly Ser His Gly Gln Thr Phe Ala Tyr Gly Glu Ala Leu Gln Lys

TCC ATC TAT TTT TAT GAG GCT CAA CAG GCC GGC CCA CTC CCG GAA TGG AAC

Ser Ile Tyr Phe Tyr Glu Ala Gln Gln Ala Gly Pro Leu Pro Glu Trp Asn

CGC GTT GCC TGG CGT GGC GAC TCA GTT CCT GAT GAC GGT GCC GAC GTC GGA

Arg Val Ala Trp Arg Gly Asp Ser Val Pro Asp Asp Gly Ala Asp Val Gly

CTG GAT TTA CGC GGT GGC TGG TTC GAT GCG GGC GAC CAC GTT AAG TTT GGC

Leu Asp Leu Arg Gly Gly Trp Phe Asp Ala Gly Asp His Val Lys Phe Gly

TTT CCA ATG GCC GCG TCA GCG ACA CTC GTC GCC TGG GGA GGC GTC GAT TAC

Phe Pro Met Ala Ala Ser Ala Thr Leu Val Ala Trp Gly Gly Val Asp Tyr

AAA GAC GCG TAC GAA CAG TCG GGG CAA ATG GAA CAT CTG CGC AAC AAC CTG

Lys Asp Ala Tyr Glu Gln Ser Gly Gln Met Glu His Leu Arg Asn Asn Leu

15/121

CGC TTC GTC AAT GAC TAC TTT ATC AGC GCG CAC CCC GCT CCG AAC GTG CTT

Arg Phe Val Asn Asp Tyr Phe Ile Ser Ala His Pro Ala Pro Asn Val Leu

TAC GGG CAG GTT GGC GAT GGC AGT GCA GAC CAT ACC TTC TGG GGT CCC GCT

Tyr Gly Gln Val Gly Asp Gly Ser Ala Asp His Thr Phe Trp Gly Pro Ala

GAG GTT CTG CAC CAC AAG ATC CCC GGC TCG CGC ATT TCT ATG AAG ATT GAC

Glu Val Leu His His Lys Ile Pro Gly Ser Arg Ile Ser Met Lys Ile Asp

GAA AGC TGC CCG GGT ACC GAT CTG GCC GCA GAG ACC GCA GCA GCG ATG GCC

Glu Ser Cys Pro Gly Thr Asp Leu Ala Ala Glu Thr Ala Ala Ala Met Ala

GCG TCT GCG ATG GTT TTT CAG GGT GAG GAC GAT GCT TAC GCA GCA ACC CTG

Ala Ser Ala Met Val Phe Gln Gly Glu Asp Asp Ala Tyr Ala Ala Thr Leu

ATC ACT CAC GCC AAA CAG CTG TGG CAA TTT GCT GAT TCA ACC AAA GGC ACA

Ile Thr His Ala Lys Gln Leu Trp Gln Phe Ala Asp Ser Thr Lys Gly Thr

ACC GGT ACA GAT ACA GCC TAT TCC AAT TGC ATA ACA GGT GCA CAG GGC TTT

Thr Gly Thr Asp Thr Ala Tyr Ser Asn Cys Ile Thr Gly Ala Gln Gly Phe

TAT ACG TCG ACG TAT GGC GTT TAC TAC GAT GAA CTT GCC TGG GGT GCT CTC

Tyr Thr Ser Thr Tyr Gly Val Tyr Tyr Asp Glu Leu Ala Trp Gly Ala Leu

16/121

TGG TTA TGG CGC GCA ACT GGA GAA GAC TTC TAC CTG GAA CAA GCC AAG CAT

Trp Leu Trp Arg Ala Thr Gly Glu Asp Phe Tyr Leu Glu Gln Ala Lys His

TAC TAC GGT TTG ATG GGC TTT GAA AAC CAG ACG ACA ACT CCG GTA TAT ACC

Tyr Tyr Gly Leu Met Gly Phe Glu Asn Gln Thr Thr Thr Pro Val Tyr Thr

TGG TCG CTT GGC TGG AAC GAT AAA GCG TAT GCC GTT TAT GTA CTT ATG GCC

Trp Ser Leu Gly Trp Asn Asp Lys Ala Tyr Ala Val Tyr Val Leu Met Ala

GCA CTT GTA GGT GAC GAG GTT TAC CAC GCA GAT GCA CAG CGC TAC CTG GAT

Ala Leu Val Gly Asp Glu Val Tyr His Ala Asp Ala Gln Arg Tyr Leu Asp

CAC TGG AGC GTC GGC GAG GGT AAC CGC ACA CCC AAT GGG CTG ATT CTG GTC

His Trp Ser Val Gly Glu Gly Asn Arg Thr Pro Asn Gly Leu Ile Leu Val

GAC TCC TGG GGG GTA AAC CGC TAT GCG GCC AAC GCG GGT TAT CTC GCA CTC

Asp Ser Trp Gly Val Asn Arg Tyr Ala Ala Asn Ala Gly Tyr Leu Ala Leu

TTT TAT GCA GAT GCG ATT GGC AGT GAC CAC CCC CTT TAT GAT CGT TAC CAC

Phe Tyr Ala Asp Ala Ile Gly Ser Asp His Pro Leu Tyr Asp Arg Tyr His

AAT TTT GGT AAG AAG CAG ATC GAT CAT ATC CTG GGC GAC AAC CCT GAC AAC

17/121

Asn Phe Gly Lys Lys Gln Ile Asp His Ile Leu Gly Asp Asn Pro Asp Asn

CAA AGC TAC GTC GTC GGC TTT GGC GAT AAT TTC CCA ATC AAT GTT CAC CAC

Gln Ser Tyr Val Val Gly Phe Gly Asp Asn Phe Pro Ile Asn Val His His

CGT GGC TCC CAC GGT TCC TGG TCC GAC AGC ATT TCC AAC CCG GTT AAT CAA

Arg Gly Ser His Gly Ser Trp Ser Asp Ser Ile Ser Asn Pro Val Asn Gln

CGC CAT GTG CTA TAC GGC GCA GTT GCC GGT GGT CCG CAG GGC GAT ACA GGC

Arg His Val Leu Tyr Gly Ala Val Ala Gly Gly Pro Gln Gly Asp Thr Gly

TAT GAA GAA GAC CGC AAT GAC TAT GTG CAG AAT GAG GTC GCA ACA GAC TAC

Tyr Glu Glu Asp Arg Asn Asp Tyr Val Gln Asn Glu Val Ala Thr Asp Tyr

AAC TCA GGC TTC ACC AGT GCC GTC GCT GCA CTT TAT GAT CAC TAT GGT GGC

Asn Ser Gly Phe Thr Ser Ala Val Ala Ala Leu Tyr Asp His Tyr Gly Gly

GCG CCC CTG GCG AAC TTC CCG CCT CCC GAA CCA GAG TCG GTG GAG TAT CTG

Ala Pro Leu Ala Asn Phe Pro Pro Pro Glu Pro Glu Ser Val Glu Tyr Leu

GTG GGG GCC AAG ATC AAT TCC TCT GGC AAC CGC TTC GTG GAA ATG AAA GCC

Val Gly Ala Lys Ile Asn Ser Ser Gly Asn Arg Phe Val Glu Met Lys Ala

18/121

GTT ATT CAA AAC CAC AGC ACA ACA CCC GCC CAA GGT AAA GAC GAC CTT TAC
Val Ile Gln Asn His Ser Thr Thr Pro Ala Gln Gly Lys Asp Asp Leu Tyr

ATG CGC TAT TTC TAT GAT CTG AGC GAA GTA TTT GCC GCA GGC TAC AGT TTG
Met Arg Tyr Phe Tyr Asp Leu Ser Glu Val Phe Ala Ala Gly Tyr Ser Leu

AAT GAT CTA ACG GTG GCG TCC GGA TAC AAC CAA GCC TCG GAT GTG AAT GGC
Asn Asp Leu Thr Val Ala Ser Gly Tyr Asn Gln Ala Ser Asp Val Asn Gly

CTG CAA CAT TGG GAT GGC AAC GTC TAC TAT GTG GAA GCC CAG TTC TAT GAC
Leu Gln His Trp Asp Gly Asn Val Tyr Tyr Val Glu Ala Gln Phe Tyr Asp

GAT GTG GTA TTT CCC GGT GGT CAG TCC GCG CAC CGA CGG GAA GTA CAA TTT
Asp Val Val Phe Pro Gly Gly Gln Ser Ala His Arg Arg Glu Val Gln Phe

CGC GTG TCC CTG CCA ACC ACA TCC AAT CTT GCC GAG TGG GAC AAC ACG AAC
Arg Val Ser Leu Pro Thr Thr Ser Asn Leu Ala Glu Trp Asp Asn Thr Asn

GAC CCC TCG TTT GAT CCA AGT TAT TTA ACG GTC GAT AGT AGT CTG ACT TAC
Asp Pro Ser Phe Asp Pro Ser Tyr Leu Thr Val Asp Ser Ser Leu Thr Tyr

GGT ATC GAC GCG CCG AAA ATT CCA CTC TAC GAC GCC AAC GGC CTG CTC TGG
Gly Ile Asp Ala Pro Lys Ile Pro Leu Tyr Asp Ala Asn Gly Leu Leu Trp

19/121

GGC GAG GAG CCA CCC CGT GGC GGA ACT TCC TCC AGC TCA TCG TCG AGC AGT

Gly Glu Glu Pro Pro Arg Gly Gly Thr Ser Ser Ser Ser Ser Ser Ser Ser

TCG TCC TCT AGC TCA TCC AGC AGT TCA TCG TCG AGC AGC TCC TCG AGC AGT

Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser

TCG TCC TCG AGT AAT TCG TCC TCT AGC TCG TCC AGC TCT TCG TCG AAT TCT

Ser Ser Ser Ser Asn Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Asn Ser

TCG TCG TCT AAC AGC AGT TCC TCG TCC AGC TCA AGC TCA TCG AGC AGT TCC

Ser Ser Ser Asn Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser

AGT TCG TCG AGT TCG GGC GGC ACC TGT GCG GAC GTG AAC GTA TAC CCC AAC

Ser Ser Ser Ser Ser Gly Gly Thr Cys Ala Asp Val Asn Val Tyr Pro Asn

TGG ACC GCA CGT GAC TGG GCC GGT GGA GTA CCG AAC CAC GCG GAA GCC GGT

Trp Thr Ala Arg Asp Trp Ala Gly Gly Val Pro Asn His Ala Glu Ala Gly

GAT TTG ATG GTT TAC CAA GGT ACT GTC TAC CAA GCT AAT TGG TAC ACC AAC

Asp Leu Met Val Tyr Gln Gly Thr Val Tyr Gln Ala Asn Trp Tyr Thr Asn

AGT GTG CCT GGC AGT GAT GCA TCC TGG ACC AAC CAA GGG TTA TGT GCC GGC

20/121

Ser Val Pro Gly Ser Asp Ala Ser Trp Thr Asn Gln Gly Leu Cys Ala Gly

GGC GGA TCC AGC TCC AGC AGC TCA TCA TCC AGC TCA AGC AGC TCT TCG TCC

Gly Gly Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser

AGC AGC AGC TCA AGC TCG TCC AGT GGT GCG TCC GGT TCA TCC TCC AGC TCG

Ser Ser Ser Ser Ser Ser Ser Ser Gly Ala Ser Gly Ser Ser Ser Ser Ser

AGC AGT TCG TCC TCG TCA AGT TCG AGC AGC AGC TCT TCG AGT TCG TCT TCT

Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser

GGT GGC GGC GCC ATG TGT AAC TGG TAT GGC TGG CAA GTA CCT ATT TGT GAA

Gly Gly Gly Ala Met Cys Asn Trp Tyr Gly Trp Gln Val Pro Ile Cys Glu

AAC ACC CCA TCT GGC TGG GGC AAC GAA AAT GGC CAA ACA TGT GTC GGC CCC

Asn Thr Pro Ser Gly Trp Gly Asn Glu Asn Gly Gln Thr Cys Val Gly Pro

GAT ACT TGC CAA GAG GTC GTC AAC TAA 2627

Asp Thr Cys Gln Glu Val Val Asn END

Figure 1D

(SEQ ID NO:7 - nucleotide sequence and SEQ ID NO:8 - amino acid sequence)

Banki gouldi mix (Clone # 37GP3) Glycosidase

1

ATG AAG ATG ACC TAC ATG CAT CCG GCT GAA GAT ACT TAC TCG TTT GGT CAA

Met Lys Met Thr Tyr Met His Pro Ala Glu Asp Thr Tyr Ser Phe Gly Gln

GCG GAT CAG TTG GTC AAC TGG GCG AAA GCG AAT GGT ATT GGC GTG CAC GGC

Ala Asp Gln Leu Val Asn Trp Ala Lys Ala Asn Gly Ile Gly Val His Gly

CAC ACT CTG GTT TGG CAC TCC GAA TAC CAG GTA CCC AAT TGG ATG AAA AAT

His Thr Leu Val Trp His Ser Glu Tyr Gln Val Pro Asn Trp Met Lys Asn

TAC TCT GGT GAT GCA ACT GCA TTC CAA ACC ATG CTC AAC ACC CAT GTG AAA

Tyr Ser Gly Asp Ala Thr Ala Phe Gln Thr Met Leu Asn Thr His Val Lys

ACT GTG GCT GAG CAT TTT GCT GGC GAA CTG GAC AGC TGG GAC GTT GTG AAT

Thr Val Ala Glu His Phe Ala Gly Glu Leu Asp Ser Trp Asp Val Val Asn

GAA GTG CTG GAG CCG GGC TCC AAT GGT TGC TGG CGT GAA AAC TCT CTG TTC

Glu Val Leu Glu Pro Gly Ser Asn Gly Cys Trp Arg Glu Asn Ser Leu Phe

TAC CAG AAG CTT GGC AAA GAC TTT GTC GCG AAC GCA TTC CGT GCA GCT CGC

Tyr Gln Lys Leu Gly Lys Asp Phe Val Ala Asn Ala Phe Arg Ala Ala Arg

GAG GGC GAT CCC AAT GCA GAC TTG TAT TAC AAC GAT TAC TCG ACT GAA AAT
Glu Gly Asp Pro Asn Ala Asp Leu Tyr Tyr Asn Asp Tyr Ser Thr Glu Asn

GGT GTA ACT TCC GAT GAG AAG TTC AGT TGT TTG TTG GAA CTA GTC GAT GAG
Gly Val Thr Ser Asp Glu Lys Phe Ser Cys Leu Leu Glu Leu Val Asp Glu

CTT CTG GAA GCG GAC GTG CCG ATT ACA GGT GTT GGT TTC CAA ATG CAC GTG
Leu Leu Glu Ala Asp Val Pro Ile Thr Gly Val Gly Phe Gln Met His Val

CAG GCG ACG TGG CCT AGC AAT GCC AAC ATC GGC AAG GCA TTC AAA GCC ATC
Gln Ala Thr Trp Pro Ser Asn Ala Asn Ile Gly Lys Ala Phe Lys Ala Ile

GCG GAT CGC GGT CTG AAA GTT AAA ATT TCT GAG CTC GAT GTT CCT GTT AAC
Ala Asp Arg Gly Leu Lys Val Lys Ile Ser Glu Leu Asp Val Pro Val Asn

AAC CCT TAC GGA ACC ACT AAT TTC CCG CAA TAC AGC AGT TTT ACC GCG GAA
Asn Pro Tyr Gly Thr Thr Asn Phe Pro Gln Tyr Ser Ser Phe Thr Ala Glu

GCC GCC GAG CTG CAG AAG CAG CGC TAC AAG GGC ATT ATG CAA GCG TAC CTT
Ala Ala Glu Leu Gln Lys Gln Arg Tyr Lys Gly Ile Met Gln Ala Tyr Leu

GAT AAC GTA CCG GCC AAC CTG CGT GGT GGT TTC ACC GTG TGG GGC GTT TGG
Asp Asn Val Pro Ala Asn Leu Arg Gly Gly Phe Thr Val Trp Gly Val Trp

23/121

GAT GGC GAT AGC TGG ATC ATG ACG TTC AGC CAG TAC ACC AAC GCT AAC GCC

Asp Gly Asp Ser Trp Ile Met Thr Phe Ser Gln Tyr Thr Asn Ala Asn Ala

AAC GAC TGG CCA CTG TTG TTC ACC GGG CCG TAA

848

Asn Asp Trp Pro Leu Leu Phe Thr Gly Pro END

Figure 1E

(SEQ ID NO:9 - nucleotide sequence and SEQ ID NO:10 - amino acid sequence)

Teredinibacter, pure (Clone # 42GP1) Glycosidase

1

ATG GGA ACA TCT CTT ATG ATC AAA TCT ACA CTG ACA GGT ATG ATT ACT GCT

Met Gly Thr Ser Leu Met Ile Lys Ser Thr Leu Thr Gly Met Ile Thr Ala

GTT GCC GCC GCA GTT TTC ACC ACC TCT GCA GCT TTC GCG GAT GTA CCT CCG

Val Ala Ala Ala Val Phe Thr Thr Ser Ala Ala Phe Ala Asp Val Pro Pro

TTG ACA GTG AGC GGA AAT CAG GTT TTA AGT GGC GGT GAA GCA AAA AGC TTC

Leu Thr Val Ser Gly Asn Gln Val Leu Ser Gly Gly Glu Ala Lys Ser Phe

GCT GGT AAC AGC TTC TTT TGG AGC AAT ACC GGA TGG GGC CAG GAA CGT TTT

Ala Gly Asn Ser Phe Phe Trp Ser Asn Thr Gly Trp Gly Gln Glu Arg Phe

TAC AAC GCA GAA ACT GTG CGT TGG TTG AAA GAC GAC TGG AAC GCA ACC ATT

Tyr Asn Ala Glu Thr Val Arg Trp Leu Lys Asp Asp Trp Asn Ala Thr Ile

GTC CGC GCC GCT ATG GGC GTA GAC TTT GAT GGC AGC TAT ATC CCC GAG CAT

Val Arg Ala Ala Met Gly Val Asp Phe Asp Gly Ser Tyr Ile Pro Glu His

GAA GAC GCC GAC CCC GAG GGT AAC GTC GCT CGC GTA CGT GCA TTG GTG GAT

Glu Asp Ala Asp Pro Glu Gly Asn Val Ala Arg Val Arg Ala Leu Val Asp

25/121

GCA GCC ATC GCA GAA GAC ATG TAC GTG ATT ATC GAT TTT CAC ACT CAC CAC
Ala Ala Ile Ala Glu Asp Met Tyr Val Ile Ile Asp Phe His Thr His His

GCA GAA GAT TAC CAA GCC GAA TCT ATC GAG TTC TTC GAA GAA ATG GCC ACA
Ala Glu Asp Tyr Gln Ala Glu Ser Ile Glu Phe Phe Glu Glu Met Ala Thr

CTG TAC GGT GGG TAC GAC AAT GTT ATT TAT GAA ATC TAT AAC GAG CCC CTG
Leu Tyr Gly Gly Tyr Asp Asn Val Ile Tyr Glu Ile Tyr Asn Glu Pro Leu

CAA ATC AGC TGG GAC AAT GTT ATT AAA CCT TAT GCA GAA TCG GTG ATT GGC
Gln Ile Ser Trp Asp Asn Val Ile Lys Pro Tyr Ala Glu Ser Val Ile Gly

GCT ATC CGC GCA ATC GAC CCG GAC AAC CTG ATT ATC GTC GGC ACG CCC ACT
Ala Ile Arg Ala Ile Asp Pro Asp Asn Leu Ile Ile Val Gly Thr Pro Thr

TGG TCA CAG GAC GTG GAC GCC GCT GCG CGC AAT CCA ATC ACC AGC TAC AGC
Trp Ser Gln Asp Val Asp Ala Ala Ala Arg Asn Pro Ile Thr Ser Tyr Ser

AAT ATT GCG TAC ACC CTG CAC TTT TAC GCA GGC ACT CAC GGT TCA TGG TTG
Asn Ile Ala Tyr Thr Leu His Phe Tyr Ala Gly Thr His Gly Ser Trp Leu

CGC GAT AAA GCG CGT AAC GCT ATG AAC AGT GGT ATT GCG CTG TTT GTG ACT
Arg Asp Lys Ala Arg Asn Ala Met Asn Ser Gly Ile Ala Leu Phe Val Thr

26/121

GAG TGG GGC ACC GTT AAT GCA GAT GGC GAT GGT GCG CCT GCA GTT AAC GAA
Glu Trp Gly Thr Val Asn Ala Asp Gly Asp Gly Ala Pro Ala Val Asn Glu

ACT CAG CAA TGG ATG GAC TTC CTC AAG CAG AAC AAT ATC TCT CAC TTG AAC
Thr Gln Gln Trp Met Asp Phe Leu Lys Gln Asn Asn Ile Ser His Leu Asn

TGG TCC GTG AGT GAT AAA TTG GAA GGT GCG TCT ATC GTA CAA CCT GGC ACG
Trp Ser Val Ser Asp Lys Leu Glu Gly Ala Ser Ile Val Gln Pro Gly Thr

CCC ATT AGC GGC TGG AAC GCT TCT GAC CTT ACG GCC TCC GGC ACA CTG GTT
Pro Ile Ser Gly Trp Asn Ala Ser Asp Leu Thr Ala Ser Gly Thr Leu Val

AAG AAC ATC GTT TCC AAC TGG GGC ACC ACA ATC GGT AAC GGC AGC TCC TCA
Lys Asn Ile Val Ser Asn Trp Gly Thr Thr Ile Gly Asn Gly Ser Ser Ser

AGT TCA TCC AGC TCC TCT TCC AGC TCT TCA AGC AGT TCT TCT TCG AGC AGT
Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser

TCC TCC TCC AGC AGC TCT TCC TCG TCA AGC AGC TCC GGA TCA ACT GGT GGC
Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Gly Ser Thr Gly Gly

GGC AAC TGT GCT GGA GTG AAT GTG TAC CCG AAC TGG ACC GCG CGT GAC TGG

27/121

Gly Asn Cys Ala Gly Val Asn Val Tyr Pro Asn Trp Thr Ala Arg Asp Trp

TCT GGC GGC GCC TAC AAC CAT GCG AAC GCT GGC GAC CAA ATG GTC TAT CAA

Ser Gly Gly Ala Tyr Asn His Ala Asn Ala Gly Asp Gln Met Val Tyr Gln

AAC AGC CTG TAT CGT GCC AAC TGG TAC ACC AAC AGC GTG CCT GGC AGC GAC

Asn Ser Leu Tyr Arg Ala Asn Trp Tyr Thr Asn Ser Val Pro Gly Ser Asp

GCC TCC TGG ACT AGC CTT GGC GCC TGC GGA GGC AAC GGA AGT ACG ACC TCA

Ala Ser Trp Thr Ser Leu Gly Ala Cys Gly Gly Asn Gly Ser Thr Thr Ser

TCC AGC TCA AGC AGC TCC TCG TCA AGC AGC AGC TCT TCT TCC AGC AGC TCC

Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser

TCG TCT ACT GGC GGT GGC TCC AGC TCC TCC AGC AGT TCA TCT TCT TCA TCG

Ser Ser Thr Gly Gly Gly Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser

TCG TCT TCC AGC AGC TCT AGC AGC ACT GGT GGC GGT CAA TGT ACC GAA GTG

Ser Ser Ser Ser Ser Ser Ser Ser Thr Gly Gly Gly Gln Cys Thr Glu Val

TGC AAC TGG TAC GGT CAG GGA ACC TAC CCA CTG TGT AAC AAC ACC AGT GGT

Cys Asn Trp Tyr Gly Gln Gly Thr Tyr Pro Leu Cys Asn Asn Thr Ser Gly

TGG GGT TGG GAA AAC AAT CAG AGC TGT ATC GGC CGT CAA ACC TGT GAG TCA
Trp Gly Trp Glu Asn Asn Gln Ser Cys Ile Gly Arg Gln Thr Cys Glu Ser

CAG AAC GGT GGC GCT GGC GGC GTG GTG AGC AAC TGC ACC GGT TCG AGT ACA
Gln Asn Gly Gly Ala Gly Gly Val Val Ser Asn Cys Thr Gly Ser Ser Thr

TCC AGC AGC TCC TCT TCC AGC AGT AGT TCT TCC TCA AGT AGC AGC TCC AGT
Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser

TCA TCC AGC AGC TCT TCA TCT GGC ACT GGT AGC AGT ACA TCT TCC AGC AGC
Ser Ser Ser Ser Ser Ser Ser Ser Gly Thr Gly Ser Ser Thr Ser Ser Ser Ser

AGC TCT TCC AGC AGC TCC AGC TCA AGT ACC GGT TCC TCC GGT ATG CCT GGA
Ser Ser Ser Ser Ser Ser Ser Ser Ser Ser Thr Gly Ser Ser Gly Met Pro Gly

CCA CGC GTG GAC AAC CCC TTC GCC GCT GCG CAG AAG TGG TAC ATA AAC CCA
Pro Arg Val Asp Asn Pro Phe Ala Ala Ala Gln Lys Trp Tyr Ile Asn Pro

ATG TGG TCA GCG AGT GCT GCA AAC GAA CCC GGC GGC TCT GTC ATT GCC AAC
Met Trp Ser Ala Ser Ala Ala Asn Glu Pro Gly Gly Ser Val Ile Ala Asn

GAA CCC TCG TTT GTA TGG ATG GAC CGT ATC GGC GCA ATC GAA GGG CCT GCT
Glu Pro Ser Phe Val Trp Met Asp Arg Ile Gly Ala Ile Glu Gly Pro Ala

29/121

GAC GGT ATG GGC CTG CGC GAC CAC TTG AAC GAA GCC CTT GCA CAA GGC GCC

Asp Gly Met Gly Leu Arg Asp His Leu Asn Glu Ala Leu Ala Gln Gly Ala

GAC CTG TTC ATG TTT GTT GTG TAC GAC CTG CCA AAC CGT GAC TGT GCT GCA

Asp Leu Phe Met Phe Val Val Tyr Asp Leu Pro Asn Arg Asp Cys Ala Ala

CTC GCC TCC AAC GGT GAA CTG CGC ATC TCC GAA GAT GGC TTC AAC ATC TAC

Leu Ala Ser Asn Gly Glu Leu Arg Ile Ser Glu Asp Gly Phe Asn Ile Tyr

AAG TCC GAC TAC ATC GCA CCT ATC GTT GAA ATC ATC AGC GAC CCT GCA TAC

Lys Ser Asp Tyr Ile Ala Pro Ile Val Glu Ile Ile Ser Asp Pro Ala Tyr

GCA GGT ATC AAA ATC GCT GCG GTT ATC GAG GTG GAC TCA CTG CCT AAC CTG

Ala Gly Ile Lys Ile Ala Ala Val Ile Glu Val Asp Ser Leu Pro Asn Leu

GTT ACC AAT CTG AGC GAA CCT GAC TGT CAG GAA GCA AAT GGT CCT GGC GGC

Val Thr Asn Leu Ser Glu Pro Asp Cys Gln Glu Ala Asn Gly Pro Gly Gly

TAC CGC GAC GGC ATT CGT CAC GCT ATC ACT GAA CTG GGC AAA ATC CCC AAC

Tyr Arg Asp Gly Ile Arg His Ala Ile Thr Glu Leu Gly Lys Ile Pro Asn

GTA TAC TCC TAC GTG GAT ATT GCA CAC TCA GGC TGG CTG GGC TGG AAC GAC

30/121

Val Tyr Ser Tyr Val Asp Ile Ala His Ser Gly Trp Leu Gly Trp Asn Asp

AAC TTC GCG CAA GGC GTT AAC CTG ATT TAT GAA GTG GTT GCC AAC CTC GGT

Asn Phe Ala Gln Gly Val Asn Leu Ile Tyr Glu Val Val Ala Asn Leu Gly

TCC GGC ATT AAC CCA ATC GCC GGT TTC GTC AGT AAC TCC GCT AAC TAC ACG

Ser Gly Ile Asn Pro Ile Ala Gly Phe Val Ser Asn Ser Ala Asn Tyr Thr

CCT GTG GAA GAA CCC TTC TTG CCA GAC GCC AAC CTG CAG GTC GGT GGT CAG

Pro Val Glu Glu Pro Phe Leu Pro Asp Ala Asn Leu Gln Val Gly Gly Gln

CCC GTT CGC TCT TCC GAT TTC TAT GAG TGG AAC AGC TAC CTG GCA GAG AAA

Pro Val Arg Ser Ser Asp Phe Tyr Glu Trp Asn Ser Tyr Leu Ala Glu Lys

CCC TTC GTG ACC GAT TGG CGT TCT GCC ATG ATC TCG AAA GGT ATG CCA AGC

Pro Phe Val Thr Asp Trp Arg Ser Ala Met Ile Ser Lys Gly Met Pro Ser

TCC ATC GGT ATG CTG ATC GAT ACC GCA CGT AAC GGC TGG GGT GGC CCT GAG

Ser Ile Gly Met Leu Ile Asp Thr Ala Arg Asn Gly Trp Gly Gly Pro Glu

CGT CCA ACT GCG CAG TCT ACC TCC AAC AAC CTG AAC ACC TTC GTT AAC GAA

Arg Pro Thr Ala Gln Ser Thr Ser Asn Asn Leu Asn Thr Phe Val Asn Glu

31/121

TCA CGT ATC GAC CGT CGT GAG CAC CGC GGC AAC TGG TGT AAC CAG CCT GGT

Ser Arg Ile Asp Arg Arg Glu His Arg Gly Asn Trp Cys Asn Gln Pro Gly

GGT GTC GGC TAC CGT CCA ACC GCT GCA CCT TCT CCA GGT ATT GAT GCC TAC

Gly Val Gly Tyr Arg Pro Thr Ala Ala Pro Ser Pro Gly Ile Asp Ala Tyr

GTT TGG GTG AAA CCA CAG GGT GAG TCT GAC GGT GTT TCC GAT CCT AAC TTC

Val Trp Val Lys Pro Gln Gly Glu Ser Asp Gly Val Ser Asp Pro Asn Phe

GAG ATC GAT CCT AAC GAC CCG AAC AAA CAG CAC GAC CCA ATG TGT GAT CCG

Glu Ile Asp Pro Asn Asp Pro Asn Lys Gln His Asp Pro Met Cys Asp Pro

TTC GCC AGC AAC TCG TCC AAC AGT GCA TAC GGC ACC GGC GCT ATG CCA AAT

Phe Ala Ser Asn Ser Ser Asn Ser Ala Tyr Gly Thr Gly Ala Met Pro Asn

GCT CCG CAC GCT GGT CGC TGG TTC CCT GAA GCC TTC CAG TTA CTG CTT GAA

Ala Pro His Ala Gly Arg Trp Phe Pro Glu Ala Phe Gln Leu Leu Leu Glu

AAC GCT TAC CCA CCA ATT AAC TAA 3032

Asn Ala Tyr Pro Pro Ile Asn END

Figure 1F

(SEQ ID NO:11 - nucleotide sequence and SEQ ID NO:12 - amino acid sequence)
Microscilla furvescens (Clone # 53GC1)

1
ATG AAC AAG AAG TGG TGG AAA GAA GCC GTG GTG TAT CAA GTC TAC CCG CGG
Met Asn Lys Lys Trp Trp Lys Glu Ala Val Val Tyr Gln Val Tyr Pro Arg

AGC TTC AAA GAC AGC AAT GGA GAT GGT GTA GGC GAT CTG CCT GGG GTT ATT
Ser Phe Lys Asp Ser Asn Gly Asp Gly Val Gly Asp Leu Pro Gly Val Ile

GAA AAG CTT GAT TAC ATC AAA AGC CTT GGG GTG GAT GTT ATC TGG CTA TGC
Glu Lys Leu Asp Tyr Ile Lys Ser Leu Gly Val Asp Val Ile Trp Leu Cys

CCG GTG TAC GAT TCC CCC AAT GAT GAC AAT GGT TAC GAT ATT CGT GAC TAC
Pro Val Tyr Asp Ser Pro Asn Asp Asp Asn Gly Tyr Asp Ile Arg Asp Tyr

TAC GAT ATC ATG GCT GAT TTC GGC ACG ATG GCT GAT TTT GAT CAG CTG CTC
Tyr Asp Ile Met Ala Asp Phe Gly Thr Met Ala Asp Phe Asp Gln Leu Leu

GAG GGA ATA CAT CAG CGT GGG ATG AAA CTG CTA ATG GAC CTG GTG GTA AAC
Glu Gly Ile His Gln Arg Gly Met Lys Leu Leu Met Asp Leu Val Val Asn

CAC TGC TCT GAT GAG CAC AAA TGG TTT CAG GAG TCC CGC AAG AGT AAA GAC
His Cys Ser Asp Glu His Lys Trp Phe Gln Glu Ser Arg Lys Ser Lys Asp

33/121

AAC CCT TAC CGG GAC TAC TTC ATC TGG AAG CCT GGC AAA AAC GGA GGC CCA
Asn Pro Tyr Arg Asp Tyr Phe Ile Trp Lys Pro Gly Lys Asn Gly Gly Pro

CCT AAC AAC TGG CAG TCC TTT TTT AGT GGT AAT GCC TGG GAA TAC GAT GAG
Pro Asn Asn Trp Gln Ser Phe Phe Ser Gly Asn Ala Trp Glu Tyr Asp Glu

GCC ACT GAC GAG TAT TAC CTA CAT CTT TTC ACC AAA AAG CAA CCA GAC CTC
Ala Thr Asp Glu Tyr Tyr Leu His Leu Phe Thr Lys Lys Gln Pro Asp Leu

AAT TGG GAA AAC CCG AAA GTA CGT GAG GAG GTG CAC AAG CTG ATG AAG TAT
Asn Trp Glu Asn Pro Lys Val Arg Glu Glu Val His Lys Leu Met Lys Tyr

TGG CTG GAC AAA GGA GTA GAT GGG TTC CGG ATG GAT GTG ATT TCC GTG ATT
Trp Leu Asp Lys Gly Val Asp Gly Phe Arg Met Asp Val Ile Ser Val Ile

TCA AAA AGA AAC TTC GAA GAT TCA CCT TAC AAG GAC TTC AAC AAG ACC ATC
Ser Lys Arg Asn Phe Glu Asp Ser Pro Tyr Lys Asp Phe Asn Lys Thr Ile

GAT AAC GTC TAC GCC AAT GGC CCG CGT GTG CAG GAG TTT CTC CAG GAA ATG
Asp Asn Val Tyr Ala Asn Gly Pro Arg Val Gln Glu Phe Leu Gln Glu Met

AAC CGT GAA GTA CTG AGT AAG TAC GAT GTG ATG ACA GTA GGT GAG GGT CCA
Asn Arg Glu Val Leu Ser Lys Tyr Asp Val Met Thr Val Gly Glu Gly Pro

34/121

GGT ATC AAT CTG GAA AGC GGC CTG CAA TAT GTA TCC AGC TCA GCG GAG GCT
Gly Ile Asn Leu Glu Ser Gly Leu Gln Tyr Val Ser Ser Ser Ala Glu Ala

CTT AAT ATG ATT TTT CAT TTT GGG CAC ATG TTT ATG GAT CAT GGA CCC GGA
Leu Asn Met Ile Phe His Phe Gly His Met Phe Met Asp His Gly Pro Gly

GGT AGA TTT GAT CCC AAG CCC ATC GAT TTT CTG GAA TTC AAA AAA GTC TTC
Gly Arg Phe Asp Pro Lys Pro Ile Asp Phe Leu Glu Phe Lys Lys Val Phe

AGG CTG TGG GAT GAG TAC CTT AAA GAA GAG GGC TGG GGT AGC GTC TTT CTA
Arg Leu Trp Asp Glu Tyr Leu Lys Glu Glu Gly Trp Gly Ser Val Phe Leu

GGG AAT CAT GAT TTT CAG CGA ATC GTT TCT CGC TTT GGG GAT GAC CGA GCG
Gly Asn His Asp Phe Gln Arg Ile Val Ser Arg Phe Gly Asp Asp Gly Ala

TAC TGG AAA GAG TCC GCC AAA CTG CTG AGC TTG TTG CTA TTT AGC ATG CGC
Tyr Trp Lys Glu Ser Ala Lys Leu Leu Ser Leu Leu Leu Phe Ser Met Arg

GGC ACG GTC TAC GTT TAC CAG GGT GAT GAA ATA GGT ATG ACC AAT GTG GCT
Gly Thr Val Tyr Val Tyr Gln Gly Asp Glu Ile Gly Met Thr Asn Val Ala

TTT GAC ACC ATA GAA GAA TAT GAC GAT GTG GAG ATC AAA AAT GCT TAC AAG

35/121

Phe Asp Thr Ile Glu Glu Tyr Asp Asp Val Glu Ile Lys Asn Ala Tyr Lys

GAG TGG AAA GCT GAA GGA AAA GAC CTG GAT CAG TTT TTA AAG AAC GTC CAT

Glu Trp Lys Ala Glu Gly Lys Asp Leu Asp Gln Phe Leu Lys Asn Val His

ATC AAT GGC CGT GAC AAT GCC CGT ACA CCG CTG CAA TGG AAT GAT GCT GAG

Ile Asn Gly Arg Asp Asn Ala Arg Thr Pro Leu Gln Trp Asn Asp Ala Glu

CAG GCT GGT TTT ACC TCA GGC ACT CCA TGG CTC AAA GTC AAC CCT AAC TAT

Gln Ala Gly Phe Thr Ser Gly Thr Pro Trp Leu Lys Val Asn Pro Asn Tyr

ACG GCA ATC AAT GTG GCT AGT CAG GAA GGA GAT GAG AAC TCT ATT CTG GCA

Thr Ala Ile Asn Val Ala Ser Gln Glu Gly Asp Glu Asn Ser Ile Leu Ala

TTT TAT CGC CGG ATG GTG GCG ATG CGA AAG GAG CAC CCG ACA CTT GTT TAT

Phe Tyr Arg Arg Met Val Ala Met Arg Lys Glu His Pro Thr Leu Val Tyr

GGT GAT TTT GCC CCC ATT CAG GAA GAT CAT CCG AGT GTA TTT GCT TTT TGG

Gly Asp Phe Ala Pro Ile Gln Glu Asp His Pro Ser Val Phe Ala Phe Trp

AGA TGG GAT GAA GAG GCT GCA TAT TTA GTC TTA CTC AAT TTT TCT GAG GAG

Arg Trp Asp Glu Glu Ala Ala Tyr Leu Val Leu Leu Asn Phe Ser Glu Glu

ACT CAG GAA TTT GGG CTG GAC GAT CGA TTT GAT AGT AGT AAG CTT CGC ATA
Thr Gln Glu Phe Gly Leu Asp Asp Arg Phe Asp Ser Ser Lys Leu Arg Ile

GTA GAG GCC AAT GAC TTT GAC TTT GGT GAG CCA CAA AGT GGA AAA GTG AAA
Val Glu Ala Asn Asp Phe Asp Phe Gly Glu Pro Gln Ser Gly Lys Val Lys

1682

CTA AAA CCG TGG CAG GCG GTG TTG GCG CGT GTT CGG CAT ATT GAA TTG TAA
Leu Lys Pro Trp Gln Ala Val Leu Ala Arg Val Arg His Ile Glu Leu END

37/121

Figure 1G

(SEQ ID NO:13 - nucleotide sequence and SEQ ID NO:14 - amino acid sequence)
Thermotoga neapolitana (Clone # 56GC2) Glycosidase

1
TCT TCT GAA CGA TTC TCC ACT GAG CAG AAA AGA CCA GAT CAT ACT CTT TGT
Ser Ser Glu Arg Phe Ser Thr Glu Gln Lys Arg Pro Asp His Thr Leu Cys

GGA CGG AAA AGA ACA TTC GGC AAA GAA GGT GGT TAT ACC ACC CTT CAA AGA
Gly Arg Lys Arg Thr Phe Gly Lys Glu Gly Gly Tyr Thr Thr Leu Gln Arg

GGA AAC GCT GGT CTT CAA AGT GAA CGG ACT GAA GAG GGG AGA GCA CCT CGT
Gly Asn Ala Gly Leu Gln Ser Glu Arg Thr Glu Glu Gly Arg Ala Pro Arg

ATC CAC CAG TCT GAA CAC GGG AAA AAC CAT CTA TGT GAG GTG ATC TGT GTG
Ile His Gln Ser Glu His Gly Lys Asn His Leu Cys Glu Val Ile Cys Val

GAG ATC TTC AAA AGA CCG TTC AGA GAA GGG AGC TTC GTT CTG AAA GAG AAG
Glu Ile Phe Lys Arg Pro Phe Arg Glu Gly Ser Phe Val Leu Lys Glu Lys

GAC TAC ACC GTT GAG TTC GAG GTG GAG AAG ATC CAT CTT GGA TGG AAG ATT
Asp Tyr Thr Val Glu Phe Glu Val Glu Lys Ile His Leu Gly Trp Lys Ile

TCA GGG AGA GTG AAG GGA AAT CCC GGA AGG CTT GAG ATC TTT CGG ACA AAC
Ser Gly Arg Val Lys Gly Asn Pro Gly Arg Leu Glu Ile Phe Arg Thr Asn

38/121

GCA CCG AAG AAA CTC CTC GTG AAC AAC TGG CAG TCC TGG GGA CCC TGC AGG
Ala Pro Lys Lys Leu Leu Val Asn Asn Trp Gln Ser Trp Gly Pro Cys Arg

GTG GTG GAT CTT CCA TCC TTC ACC CCA CCC GAG ATA GAT CCA AAC TGG CAG
Val Val Asp Leu Pro Ser Phe Thr Pro Pro Glu Ile Asp Pro Asn Trp Gln

TAC ACG GCC TCT GTG GTA CCG GAT GTG ATC AAA AAC CGT CTT CAG AGT GAC
Tyr Thr Ala Ser Val Val Pro Asp Val Ile Lys Asn Arg Leu Gln Ser Asp

TAC TTC GTG GCA GAG GAA GGG AGA GTA TAC GGT TTT TTG AGT TCG AAG ATC
Tyr Phe Val Ala Glu Glu Gly Arg Val Tyr Gly Phe Leu Ser Ser Lys Ile

GCA CAT CCT TTC TTT GCG GCA GAG AAT GGA GAA CTT GTT GCG TAT CTT GAG
Ala His Pro Phe Phe Ala Ala Glu Asn Gly Glu Leu Val Ala Tyr Leu Glu

TAC TTC GAT GTG AAT TTC GAT GAC TTC GTC CCG ATA GAA CCT TTT GTC GTC
Tyr Phe Asp Val Asn Phe Asp Asp Phe Val Pro Ile Glu Pro Phe Val Val

CTT GAA AAT CCA ATC ACC TCT CTC CTT CTG GAA AAG TAC GCT GAA CTC GTC
Leu Glu Asn Pro Ile Thr Ser Leu Leu Leu Glu Lys Tyr Ala Glu Leu Val

GGG AAG GAA AAC AGC GCG AGG ATT CCA AAA CGT ACA CCG GTT GGA TGG TGC
Gly Lys Glu Asn Ser Ala Arg Ile Pro Lys Arg Thr Pro Val Gly Trp Cys

39/121

AGC TGG TAC CAC TAT TTC CTC GAT CTC ACC TGG GAG GAG ACT TTG AAG AAT

Ser Trp Tyr His Tyr Phe Leu Asp Leu Thr Trp Glu Glu Thr Leu Lys Asn

CTG GAA CTT GCA GGA GAG TTT CCC TTC GAG GTC TTT CAG ATA GAC GAC GCG

Leu Glu Leu Ala Gly Glu Phe Pro Phe Glu Val Phe Gln Ile Asp Asp Ala

TAT GAA AAA GAC ATC GGA GAC TGG CTC GTC ACG AAG AAA GAC TTC CCA TCT

Tyr Glu Lys Asp Ile Gly Asp Trp Leu Val Thr Lys Lys Asp Phe Pro Ser

GTG GAC GAG ATG GCA AGG ACG ATA CAG GAG AAA GGC TTT GTT CCT GGT ATA

Val Asp Glu Met Ala Arg Thr Ile Gln Glu Lys Gly Phe Val Pro Gly Ile

TGG ACC GCA CCG TTC AGT GTT TCA GAA ACA TCG GAT GTG TTC AAC TCC TAT

Trp Thr Ala Pro Phe Ser Val Ser Glu Thr Ser Asp Val Phe Asn Ser Tyr

CCG GAC TGG GTC GTG AAG GAA AAC GGA ATG CCA AAG ATG GCG TAC AGG AAC

Pro Asp Trp Val Val Lys Glu Asn Gly Met Pro Lys Met Ala Tyr Arg Asn

TGG AAC AGA AAG ATC TAC GCT CTT GAC CTT TCA AAC AAA GAA GTC CTG GAC

Trp Asn Arg Lys Ile Tyr Ala Leu Asp Leu Ser Asn Lys Glu Val Leu Asp

TGG CTC TTC GAC CTC TTC AGC TCT CTC AAG AAG ATG GGC TAC AGA TAC TTC

40/121

Trp Leu Phe Asp Leu Phe Ser Ser Leu Lys Lys Met Gly Tyr Arg Tyr Phe

AAG ATC GAC TTT CTC TTT GCA GGA GCG ATT CCG GGT GAG AGG AAA GAA AAC

Lys Ile Asp Phe Leu Phe Ala Gly Ala Ile Pro Gly Glu Arg Lys Glu Asn

ATC ACA CCC GTT CAG GCG TTC AGA AAG GGG ATG GAG GTG ATC AGA AAG GCG

Ile Thr Pro Val Gln Ala Phe Arg Lys Gly Met Glu Val Ile Arg Lys Ala

GTT GGA GAC TTG TTC ATA CTC GGA TGT GGC TCT CCC CTT CTT CCT GCG GTG

Val Gly Asp Leu Phe Ile Leu Gly Cys Gly Ser Pro Leu Leu Pro Ala Val

GGC TAC GTT GAC GGC ATG AGG ATA GGG CCG GAC ACC ACA CCC TTC TGG GGT

Gly Tyr Val Asp Gly Met Arg Ile Gly Pro Asp Thr Thr Pro Phe Trp Gly

GAT CAA ATA GAA GAC AAC GGA GCA CCC GCT GCA AGA TGG GCT CTG AGA AAT

Asp Gln Ile Glu Asp Asn Gly Ala Pro Ala Ala Arg Trp Ala Leu Arg Asn

GCC ATC ACA CGT TAC TTC ATG CAC GAC AGA CTC TGG CTG AAC GAT CCG GAC

Ala Ile Thr Arg Tyr Phe Met His Asp Arg Leu Trp Leu Asn Asp Pro Asp

TGC CTC ATC CTG AGA GAG GAA AAA ACA GAA CTG ACC CCA AAA GAG AGA GAG

Cys Leu Ile Leu Arg Glu Glu Lys Thr Glu Leu Thr Pro Lys Glu Arg Glu

41/121

CTC TAC TCG TAC ACC TGT GGG ATC CTC GAC AAC ATG ATC ATA GAA AGT GAC
Leu Tyr Ser Tyr Thr Cys Gly Ile Leu Asp Asn Met Ile Ile Glu Ser Asp

GAC CTG TCA CTT GTG AAA GAG CAC GGA AGG AAG GTT CTG AGA GAG ACA CTC
Asp Leu Ser Leu Val Lys Glu His Gly Arg Lys Val Leu Arg Glu Thr Leu

GAT CTT CTC GGG GGA AAG CCC CGT GTT CTG AAC ATC ATG ACA GAG GAT CTG
Asp Leu Leu Gly Gly Lys Pro Arg Val Leu Asn Ile Met Thr Glu Asp Leu

AAG TAC GAG ATC GTC TCG TCT GGC ACG ATC TCT GGA AAC ACC AGG CTC GTT
Lys Tyr Glu Ile Val Ser Ser Gly Thr Ile Ser Gly Asn Thr Arg Leu Val

GTC GAT CTC AAA AAC AGA GAG TAC CAT CTG GAA AAA GAG GGA AAG TCC TCT
Val Asp Leu Lys Asn Arg Glu Tyr His Leu Glu Lys Glu Gly Lys Ser Ser

CTG AGA AAG AAG GTT GTC AAA AGA GAA GAC GGA AGA AAC TTC TAC TTC TAC
Leu Arg Lys Lys Val Val Lys Arg Glu Asp Gly Arg Asn Phe Tyr Phe Tyr

GAA GAG GGT GAG AGA GAA TGA 1856
Glu Glu Gly Glu Arg Glu END

42/121

Figure 1H

(SEQ ID NO:15 - nucleotide sequence and SEQ ID NO:16 - amino acid sequence)
Thermotoga neapolitana (Clone # 56GP1) Glycosidase

1
ATG AGA AAA CTT GTG TTC TCA TTT TTG ATT GTG ACA TTG CCC ATC GTC CTC
Met Arg Lys Leu Val Phe Ser Phe Leu Ile Val Thr Leu Pro Ile Val Leu
TTT GCA AAC AGT GAT TTC GTG AAA GTG GAA AAC GGC AGG TTC ATA CTG AAC
Phe Ala Asn Ser Asp Phe Val Lys Val Glu Asn Gly Arg Phe Ile Leu Asn
GGA GAA GAG TTC AGA TTC GTT GGA AGC AAC AAC TAC TAC ATG CAC TAC AAG
Gly Glu Glu Phe Arg Phe Val Gly Ser Asn Asn Tyr Tyr Met His Tyr Lys
AGC AAT CGA ATG ATA GAC AGT GTC CTT GAA AGT GCA AAA GCC ATG GGG GTG
Ser Asn Arg Met Ile Asp Ser Val Leu Glu Ser Ala Lys Ala Met Gly Val
AAG GTG CTC AGA ATT TGG GGA TTC CTC GAT GGT GAG AGT TAC TGC CGT GAC
Lys Val Leu Arg Ile Trp Gly Phe Leu Asp Gly Glu Ser Tyr Cys Arg Asp
AAG AAC ACC TAC ATG CAC CCC GCA CCG GGA GTA TTT GGA TTG CCA GAG GGT
Lys Asn Thr Tyr Met His Pro Ala Pro Gly Val Phe Gly Leu Pro Glu Gly
ACG AAC GCT CAG GAC GGT TTT GAA AGA CTC GAC TAC ACG GTA GCG AAA GCA
Thr Asn Ala Gln Asp Gly Phe Glu Arg Leu Asp Tyr Thr Val Ala Lys Ala

43/121

AAA GAA CTG GGC ATA AAG CTC ATA ATC GTT CTT GTG AAC AAC TGG GAC GAC

Lys Glu Leu Gly Ile Lys Leu Ile Ile Val Leu Val Asn Asn Trp Asp Asp

TTC GGT GGA ATG AAT CAA TAC GTG AGA TGG TTT GGG GGC ATC CAT CAC GAT

Phe Gly Gly Met Asn Gln Tyr Val Arg Trp Phe Gly Gly Ile His His Asp

GAC TTC TAC AGG AAC GAG AAG ATC AAA GAA GAA TAC AAA AAG TAC GTG TCT

Asp Phe Tyr Arg Asn Glu Lys Ile Lys Glu Glu Tyr Lys Lys Tyr Val Ser

TTC CTC ATA AAC AGG GTG AAC ACC TAC ACG GGT GTT CCT TAC AGG GAA GAG

Phe Leu Ile Asn Arg Val Asn Thr Tyr Thr Gly Val Pro Tyr Arg Glu Glu

CCC ACC ATC ATG GCA TGG GAA CTG GCG AAC GAG CCC AGG TGT GAA ACG GAC

Pro Thr Ile Met Ala Trp Glu Leu Ala Asn Glu Pro Arg Cys Glu Thr Asp

AAG TCT GGT AAC ACA CTC GTT GAA TGG GTA GAG GAG ATG AGT GCT TAC ATA

Lys Ser Gly Asn Thr Leu Val Glu Trp Val Glu Glu Met Ser Ala Tyr Ile

AAG AGT CTG GAT CCA AAC CAC CTG GTT GCC GTG GGA GAC GAG GGA TTC TTC

Lys Ser Leu Asp Pro Asn His Leu Val Ala Val Gly Asp Glu Gly Phe Phe

AAC AAC TAC GAA GGC TTC AGA CCT TAC GGT GGA GAG GCT GAG TGG GCC TAC

Asn Asn Tyr Glu Gly Phe Arg Pro Tyr Gly Gly Glu Ala Glu Trp Ala Tyr

44/121

AAC GGA TGG TCC GGT GTT GAC TGG AAG AGA CTT CTG GAG ATA GAG ACG GTG

Asn Gly Trp Ser Gly Val Asp Trp Lys Arg Leu Leu Glu Ile Glu Thr Val

GAT TTT GGT ACG TTC CAT CTC TAC CCC TCC CAC TGG GGT GTG AGC CCT GAA

Asp Phe Gly Thr Phe His Leu Tyr Pro Ser His Trp Gly Val Ser Pro Glu

AAC TAC GCA CAG TGG GGG GCA AAG TGG ATA GAA GAT CAC ATA AAG ATC GCA

Asn Tyr Ala Gln Trp Gly Ala Lys Trp Ile Glu Asp His Ile Lys Ile Ala

AAA GAG GTT GGA AAA CCC GTC GTT CTG GAA GAG TAC GGT ATT CCC AAA AGT

Lys Glu Val Gly Lys Pro Val Val Leu Glu Glu Tyr Gly Ile Pro Lys Ser

GCC CCG GTC AAC AGG GTT GCC ATT TAC AAA TTG TGG AAC GAT CTG GTC TAC

Ala Pro Val Asn Arg Val Ala Ile Tyr Lys Leu Trp Asn Asp Leu Val Tyr

AAC CTC GGT GGA AAC GGT GCC ATG TTC TGG ATG CTC GCA GGA ATC GGT GAA

Asn Leu Gly Gly Asn Gly Ala Met Phe Trp Met Leu Ala Gly Ile Gly Glu

GGA TGG GAC AGA GAC GAA AAG GGT TAC TAC CCC GAT TAC GAC GGC TTC AGA

Gly Trp Asp Arg Asp Glu Lys Gly Tyr Tyr Pro Asp Tyr Asp Gly Phe Arg

ATA GTG AAC GAT GAA AGT GAA GAG GCA AAG TTG ATC AGA GAG TAC GCG AAA

45/121

Ile Val Asn Asp Glu Ser Glu Glu Ala Lys Leu Ile Arg Glu Tyr Ala Lys

CTG TTC AGC ACG GGT GAG GAT ACG AGG GAA GAT ACC TGC ATG TTC ATC ACA

Leu Phe Ser Thr Gly Glu Asp Thr Arg Glu Asp Thr Cys Met Phe Ile Thr

CCA AAG GAT GGT CAG GAG ATC AAA AAG ACT GTG AAG GTG AGA GTG GGT GTC

Pro Lys Asp Gly Gln Glu Ile Lys Lys Thr Val Lys Val Arg Val Gly Val

TTC GAC TAC AGC AAC ACG TTC AAA GGA ATT TCC GTC GGG GTT GAA AAT CTG

Phe Asp Tyr Ser Asn Thr Phe Lys Gly Ile Ser Val Gly Val Glu Asn Leu

CTC TTT GAA GAT GAG ATA AAA CAT CTC GGA TAT GGA GTT TAC GGA TTC GAA

Leu Phe Glu Asp Glu Ile Lys His Leu Gly Tyr Gly Val Tyr Gly Phe Glu

TTT GAC ACA ACG CGG ATT TCA GAC GGA GAA CAC GAG ATG TTC CTT GAG GCA

Phe Asp Thr Thr Arg Ile Ser Asp Gly Glu His Glu Met Phe Leu Glu Ala

CAT TTC AGG GGA GAA ACG GTG AAA GAC ACA ATC AGG GTG AAA GTT GTG AAC

His Phe Arg Gly Glu Thr Val Lys Asp Thr Ile Arg Val Lys Val Val Asn

AGA GCG CAG TAT GTA CTC GCA GAA GAA GTG GAT TTT TCC AGA CCC GAA GAA

Arg Ala Gln Tyr Val Leu Ala Glu Glu Val Asp Phe Ser Arg Pro Glu Glu

46/121

GTC AAG AAC TGG TGG AAC AGC GGA ACA TGG CAG GCT GAG TTC AAA ACA CCC
Val Lys Asn Trp Trp Asn Ser Gly Thr Trp Gln Ala Glu Phe Lys Thr Pro

GAT ATA GAG TGG AAC GGT GAG GTG GGG AAC GGT GCT CTC CAG ATG AAC GTG
Asp Ile Glu Trp Asn Gly Glu Val Gly Asn Gly Ala Leu Gln Met Asn Val

GTG CTT CCC GGA AAG GGT GAC TGG GAA GAG GTG AGG GTG GTC AGG AAA TTC
Val Leu Pro Gly Lys Gly Asp Trp Glu Glu Val Arg Val Val Arg Lys Phe

GAT CAA CTC CCC GTG TGT GAG ATC CTC GAG TAC GAT ATC TAC ATA CCA GAC
Asp Gln Leu Pro Val Cys Glu Ile Leu Glu Tyr Asp Ile Tyr Ile Pro Asp

GTT GAA GGG CTT ACA GGA AGG CTC AGA CCG TAC GCG GTG CTG AAT CCC GGC
Val Glu Gly Leu Thr Gly Arg Leu Arg Pro Tyr Ala Val Leu Asn Pro Gly

TGG GTG AAG ATA GGG CTC GAC ATG AAC AAC ACC TCG ATT GAC AGC GGA GAA
Trp Val Lys Ile Gly Leu Asp Met Asn Asn Thr Ser Ile Asp Ser Gly Glu

CTT GTC AGT TTC GAT GGC AAA AAG TAC AGA AAG TTC CAT GTG AGG ATC GAG
Leu Val Ser Phe Asp Gly Lys Lys Tyr Arg Lys Phe His Val Arg Ile Glu

TTC GAC AAG ACA CCT GGA GTG AAC GAG CTC CAC ATA GGT GTA GTT GGA GAC
Phe Asp Lys Thr Pro Gly Val Asn Glu Leu His Ile Gly Val Val Gly Asp

47/121

CAC CTG GAG TAT GAT GGG CCG ATT TTC ATC GAT AAT GTG AGG CTC TAT AAA

His Leu Glu Tyr Asp Gly Pro Ile Phe Ile Asp Asn Val Arg Leu Tyr Lys

AAA TCT TCT TGA 2000

Lys Ser Ser END

Figure 11

(SEQ ID NO:17 - nucleotide sequence and SEQ ID NO:18 - amino acid sequence)
ARP 2.3 (Alum Rock sulfur spring, Clone # 58GB3) Glycosidase

1

ATG CAT TTT AGC CCA CTA CAA TTG ATC CTC GTC TTA GTC ATT GTC ATT CTG

Met His Phe Ser Pro Leu Gln Leu Ile Leu Val Leu Val Ile Val Ile Leu

CTG TTT GGC ACC AAA AAA TTA CGC AAT ATG GGC GGC GAT TTA GGC GAA GCC

Leu Phe Gly Thr Lys Lys Leu Arg Asn Met Gly Gly Asp Leu Gly Glu Ala

TTC AAG AAT TTC AGA AAA GCA GTC AAA GAC GGC GAT GAT GCT GAA ACA CAA

Phe Lys Asn Phe Arg Lys Ala Val Lys Asp Gly Asp Asp Ala Glu Thr Gln

AAA GAT GTT GCT GTG CAA AAA GTT GAC CAA CAG CCA CCA GCA CAG CCC ATC

Lys Asp Val Ala Val Gln Lys Val Asp Gln Gln Pro Pro Ala Gln Pro Ile

254

CCA CAA GGT CGA GTC ATT GAT TCG GAA GCC AAG GAA AAG GAT AAG GTC TAA

Pro Gln Gly Arg Val Ile Asp Ser Glu Ala Lys Glu Lys Asp Lys Val END

Figure 1J

(SEQ ID NO:19 - nucleotide sequence and SEQ ID NO:20 - amino acid sequence)
AEPII 1a (Clone # 63GA3) Glycosidase

1

ATG GAA GGA CTT CGA GGA GGT GTG AGG ATG AAG TTC CCA TCT AAC TTT CTT

Met Glu Gly Leu Arg Gly Gly Val Arg Met Lys Phe Pro Ser Asn Phe Leu

TTT GGC TAC TCC TGG TCG GGC TTC CAG TTT GAA ATG GGT TTA CCT GGG AGT

Phe Gly Tyr Ser Trp Ser Gly Phe Gln Phe Glu Met Gly Leu Pro Gly Ser

GAA GTT GAG AGC GAC TGG TGG GCA TGG GTC CAC GAT AAG GAG AAC ATC TTC

Glu Val Glu Ser Asp Trp Trp Ala Trp Val His Asp Lys Glu Asn Ile Phe

TCG GGC CTA GTT AGC GGT GAC CTA CCA GAG AAC GGG CCT GCT TAC TGG CAC

Ser Gly Leu Val Ser Gly Asp Leu Pro Glu Asn Gly Pro Ala Tyr Trp His

CTC TAC AAG AAA GAC CAC GAC ATA GCT GAA AGC CTT GGC ATG GAC GCG ATA

Leu Tyr Lys Lys Asp His Asp Ile Ala Glu Ser Leu Gly Met Asp Ala Ile

AGA GGC GGA ATC GAG TGG GCG AGG ATC TTC CCA AAA CCC ACC TTT GAC GTG

Arg Gly Gly Ile Glu Trp Ala Arg Ile Phe Pro Lys Pro Thr Phe Asp Val

AAG GTT GAC GTG GAA AAG GAC GAA AAC GGG AAC ATA ATC TCC ATT GAC GTC

Lys Val Asp Val Glu Lys Asp Glu Asn Gly Asn Ile Ile Ser Ile Asp Val

CCG GAG AGC GCG ATA GAG GAG CTA GAA AAG CTT GCC AAC ATG GAT GCC CTC
Pro Glu Ser Ala Ile Glu Glu Leu Glu Lys Leu Ala Asn Met Asp Ala Leu

AAC CAC TAC CGC GAA ATC TAC TCG GAC TGG AAG GAG AGG GGC AAG ACC TTC
Asn His Tyr Arg Glu Ile Tyr Ser Asp Trp Lys Glu Arg Gly Lys Thr Phe

ATA TTG AAC CTC TAT CAC TGG CCC CTT CCC CTC TGG CTC CAC GAC CCG ATA
Ile Leu Asn Leu Tyr His Trp Pro Leu Pro Leu Trp Leu His Asp Pro Ile

GGC GTT AGA AAG CTC GGC CCT GAT AGA GCT CCC TCG GGC TGG CTG GAC GAG
Gly Val Arg Lys Leu Gly Pro Asp Arg Ala Pro Ser Gly Trp Leu Asp Glu

AGG AGC GTG GTG GAG TTC ACC AAG TTC GCT GCA TTC ATC GCC TAC CAC TTG
Arg Ser Val Val Glu Phe Thr Lys Phe Ala Ala Phe Ile Ala Tyr His Leu

GAT GAC CTC GTT GAC ATG TGG AGC ACG ATG AAC GAG CCG AAT GTG GTT TAC
Asp Asp Leu Val Asp Met Trp Ser Thr Met Asn Glu Pro Asn Val Val Tyr

GAG CAG GGT TAC ACG AGG CCT CAG TCG GGC TTT CCA CCG GGT TAT CTC AGC
Glu Gln Gly Tyr Thr Arg Pro Gln Ser Gly Phe Pro Pro Gly Tyr Leu Ser

CAC GAG GCC GCT GGA AAG GCG AAG CTC AAC CTC ATG CAG GCT CAC GCT AGA
His Glu Ala Ala Gly Lys Ala Lys Leu Asn Leu Met Gln Ala His Ala Arg

51/121

GCT TAC GAT GCG ATA AAA GAG CAC TCG GAC AAG CCC GTG GGG TTG ATA TAC

Ala Tyr Asp Ala Ile Lys Glu His Ser Asp Lys Pro Val Gly Leu Ile Tyr

TCC TTT GTC TGG CAC GAT GCC CTA AAC GAG GAA GCG GAG GAG ATT GTG AAG

Ser Phe Val Trp His Asp Ala Leu Asn Glu Glu Ala Glu Glu Ile Val Lys

GAG ATA AGG AGG AGA CAC TAC GAC TTC GTA ACC GGC CTT CAC TCC GGC TCA

Glu Ile Arg Arg Arg His Tyr Asp Phe Val Thr Gly Leu His Ser Gly Ser

TCG GAG TTC GGG GAG AGG GAG GAC TTC AAG GGG AAG ATC GAC TGG ATA GGC

Ser Glu Phe Gly Glu Arg Glu Asp Phe Lys Gly Lys Ile Asp Trp Ile Gly

GTG AAC TAC TAC ACT AGG GTT GCT TAC GAG ATG AGG AAC GGC CGC TTT ATG

Val Asn Tyr Tyr Thr Arg Val Ala Tyr Glu Met Arg Asn Gly Arg Phe Met

GCC CTA CCC GGG TAC GGC TAC ATG TGC GAG AGG AGT GGT TAC GCA AAA TCC

Ala Leu Pro Gly Tyr Gly Tyr Met Cys Glu Arg Ser Gly Tyr Ala Lys Ser

GGA AGG CCC GCG AGC GAT TTT GGC TGG GAG ACC TAT CCT GAG GGC CTC GAA

Gly Arg Pro Ala Ser Asp Phe Gly Trp Glu Thr Tyr Pro Glu Gly Leu Glu

AAC GTC CTG ATG GAT CTG AAG GAG CTC TAC GGC CTG CCA ATG ATG GTG ACG

52/121

Asn Val Leu Met Asp Leu Lys Glu Leu Tyr Gly Leu Pro Met Met Val Thr

GAG AAC GGG ATG GCG GAT ATG GCA GAC AGG CAC CGC TCT TAC TAC CTC GTG

Glu Asn Gly Met Ala Asp Met Ala Asp Arg His Arg Ser Tyr Tyr Leu Val

AGC CAC CTC GCG GCT ATC CAC AGG GCG ATG GAG AAG GGT GCC GAC GTT AGG

Ser His Leu Ala Ala Ile His Arg Ala Met Glu Lys Gly Ala Asp Val Arg

GGG TAC CTC CAC TGG TCT CTG ACC GAC AAC TAC GAG TGG GCG CAG GGC TTC

Gly Tyr Leu His Trp Ser Leu Thr Asp Asn Tyr Glu Trp Ala Gln Gly Phe

AGA ATG CGC TTT GGG CTG GTG ATG GTG GAC TTC GAG ACT AAG AAG CGC TAC

Arg Met Arg Phe Gly Leu Val Met Val Asp Phe Glu Thr Lys Lys Arg Tyr

ATA AGG CCG AGC GCA CTC GTC TTC AGG GAG ATA GCC ACG CAG AAG GAA ATA

Ile Arg Pro Ser Ala Leu Val Phe Arg Glu Ile Ala Thr Gln Lys Glu Ile

1478

CCC GAA GAG CTC TCC CAC CTA GCG AAC CTC GAA CTG GTA ACG AAG AAG TAA

Pro Glu Glu Leu Ser His Leu Ala Asn Leu Glu Leu Val Thr Lys Lys END

53/121

Figure 1K

(SEQ ID NO:21 - nucleotide sequence and SEQ ID NO:22 - amino acid sequence)
AEPII 1a (Clone # 63GA4) Glycosidase

1

ATG AAG TTC CCA TCT AAC TTT CTT TTT GGC TAC TCC TGG TCG GGC TTC CAG

Met Lys Phe Pro Ser Asn Phe Leu Phe Gly Tyr Ser Trp Ser Gly Phe Gln

TTT GAA ATG GGT TTA CCT GGG AGT GAA GTT GAG AGC GAC TGG TGG GCA TGG

Phe Glu Met Gly Leu Pro Gly Ser Glu Val Glu Ser Asp Trp Trp Ala Trp

GTC CAC GAT AAG GAG AAC ATC TTC TCG GGC CTA GTT AGC GGT GAC CTA CCA

Val His Asp Lys Glu Asn Ile Phe Ser Gly Leu Val Ser Gly Asp Leu Pro

GAG AAC GGG CCT GCT TAC TGG CAC CTC TAC AAG AAA GAC CAC GAC ATA GCT

Glu Asn Gly Pro Ala Tyr Trp His Leu Tyr Lys Lys Asp His Asp Ile Ala

GAA AGC CTT GGC ATG GAC GCG ATA AGA GGC GGA ATC GAG TGG GCG AGG ATC

Glu Ser Leu Gly Met Asp Ala Ile Arg Gly Gly Ile Glu Trp Ala Arg Ile

TTC CCA AAA CCC ACC TTT GAC GTG AAG GTT GAC GTG GAA AAG GAC GAA AAC

Phe Pro Lys Pro Thr Phe Asp Val Lys Val Asp Val Glu Lys Asp Glu Asn

GGG AAC ATA ATC TCC ATT GAC GTC CCG GAG AGC GCG ATA GAG GAG CTA GAA

Gly Asn Ile Ile Ser Ile Asp Val Pro Glu Ser Ala Ile Glu Glu Leu Glu

54/121

AAG CTT GCC AAC ATG GAT GCC CTC AAC CAC TAC CGC GAA ATC TAC TCG GAC
Lys Leu Ala Asn Met Asp Ala Leu Asn His Tyr Arg Glu Ile Tyr Ser Asp

TGG AAG GAG AGG GGC AAG ACC TTC ATA TTG AAC CTC TAT CAC TGG CCC CTT
Trp Lys Glu Arg Gly Lys Thr Phe Ile Leu Asn Leu Tyr His Trp Pro Leu

CCC CTC TGG CTC CAC GAC CCG ATA GGC GTT AGA AAG CTC GGC CCT GAT AGA
Pro Leu Trp Leu His Asp Pro Ile Gly Val Arg Lys Leu Gly Pro Asp Arg

GCT CCC TCG GGC TGG CTG GAC GAG AGG AGC GTG GTG GAG TTC ACC AAG TTC
Ala Pro Ser Gly Trp Leu Asp Glu Arg Ser Val Val Glu Phe Thr Lys Phe

GCT GCA TTC ATC GCC TAC CAC TTG GAT GAC CTC GTT GAC ATG TGG AGC ACG
Ala Ala Phe Ile Ala Tyr His Leu Asp Asp Leu Val Asp Met Trp Ser Thr

ATG AAC GAG CCG AAT GTG GTT TAC GAG CAG GGT TAC ACG AGG CCT CAG TCG
Met Asn Glu Pro Asn Val Val Tyr Glu Gln Gly Tyr Thr Arg Pro Gln Ser

GGC TTT CCA CCG GGT TAT CTC AGC CAC GAG GCC GCT GGA AAG GCG AAG CTC
Gly Phe Pro Pro Gly Tyr Leu Ser His Glu Ala Ala Gly Lys Ala Lys Leu

AAC CTC ATG CAG GCT CAC GCT AGA GCT TAC GAT GCG ATA AAA GAG CAC TCG
Asn Leu Met Gln Ala His Ala Arg Ala Tyr Asp Ala Ile Lys Glu His Ser

55/121

GAC AAG CCA GTT GGA GTT ATC TAC GCA TAT AAG TGG ATT GAT GCG GAG GAT

Asp Lys Pro Val Gly Val Ile Tyr Ala Tyr Lys Trp Ile Asp Ala Glu Asp

GAA GCT GCA GAG GAA TCC GTT CTG GAA CTC CGC AGG AGG GAT TAC GAC TTC

Glu Ala Ala Glu Glu Ser Val Leu Glu Leu Arg Arg Arg Asp Tyr Asp Phe

GTT GAT GGT CTC TAC TCA GGC AAG TCC CTG ACT GCA GGT GAG AGG GAG GAC

Val Asp Gly Leu Tyr Ser Gly Lys Ser Leu Thr Ala Gly Glu Arg Glu Asp

TTC AAA GGC AGG GTC GAC TGG GTT GGC GTC AAC TAC TAC TCC CGC CTG CTC

Phe Lys Gly Arg Val Asp Trp Val Gly Val Asn Tyr Tyr Ser Arg Leu Leu

TTT GGA AAG GCC GGA GAT TCA GTG AGA TTA CTT GAG GGC TAC GGT TTT GTC

Phe Gly Lys Ala Gly Asp Ser Val Arg Leu Leu Glu Gly Tyr Gly Phe Val

TCC CCG AGG GGT GGC TAC GCC AAA TCG GGA AGG CCT GCG AGC GAT TTT GGC

Ser Pro Arg Gly Gly Tyr Ala Lys Ser Gly Arg Pro Ala Ser Asp Phe Gly

TGG GAG ATT TAT CCT GAG GGC CTC GAA AAG CTC CTG GTT GAG CTG AGT GGC

Trp Glu Ile Tyr Pro Glu Gly Leu Glu Lys Leu Leu Val Glu Leu Ser Gly

AGG TAC GAG CTT CCG CTC TTC ATA ACG GAG AAT GGT ATG GCT GAT GCT GTC

56/121

Arg Tyr Glu Leu Pro Leu Phe Ile Thr Glu Asn Gly Met Ala Asp Ala Val

GAT AGG TAC AGG CCT TAC TAC CTC GTG AGC CAC CTC GCG GCT ATC CAC AGG

Asp Arg Tyr Arg Pro Tyr Tyr Leu Val Ser His Leu Ala Ala Ile His Arg

GCG ATG GAG AAG GGT GCC GAC ATT AGG GGG TAC CTC CAC TGG TCT CTG ACC

Ala Met Glu Lys Gly Ala Asp Ile Arg Gly Tyr Leu His Trp Ser Leu Thr

GAC AAC TAC GAG TGG GCG CAG GGC TTC AGA ATG CGC TTT GGG CTG GTG ATG

Asp Asn Tyr Glu Trp Ala Gln Gly Phe Arg Met Arg Phe Gly Leu Val Met

GTG GAC TTC GAG ACT AAG AAG CGC TAC TTG AGG CCG AGC GCA CTC GTC TTC

Val Asp Phe Glu Thr Lys Lys Arg Tyr Leu Arg Pro Ser Ala Leu Val Phe

AGG GAA ATA GCC ACG CGG AAG GAA ATA CCC GAA GAG CTT GAA CAC CTT GCC

Arg Glu Ile Ala Thr Arg Lys Glu Ile Pro Glu Glu Leu Glu His Leu Ala

GAT GTG GAT GCA ATC ATT GCT CGG TGA 1454

Asp Val Asp Ala Ile Ile Ala Arg END

Figure 1L

(SEQ ID NO:23 - nucleotide sequence and SEQ ID NO:24 - amino acid sequence)
AEPII 1a (Clone #63GA9) Glycosidase

1

ATG CTA CCA GAA GAG TTC CTA TGG GGC GTT GGG CAG TCA GGC TTT CAG TTC

Met Leu Pro Glu Glu Phe Leu Trp Gly Val Gly Gln Ser Gly Phe Gln Phe

GAA ATG GGC GAC AAG CTC AGG AGG CAC ATC GAT CCA AAT ACC GAC TGG TGG

Glu Met Gly Asp Lys Leu Arg Arg His Ile Asp Pro Asn Thr Asp Trp Trp

AAG TGG GTT CGC GAT CCT TTC AAC ATA AAA AAG GAG CTT GTG AGT GGG GAC

Lys Trp Val Arg Asp Pro Phe Asn Ile Lys Lys Glu Leu Val Ser Gly Asp

CTT CCC GAG GAC GGC ATC AAC AAC TAC GAA CTT TTT GAA AAC GAT CAC AAG

Leu Pro Glu Asp Gly Ile Asn Asn Tyr Glu Leu Phe Glu Asn Asp His Lys

CTC GCT AAA GGC CTT GGA CTC AAC GCA TAC AGG ATT GGA ATA GAG TGG AGC

Leu Ala Lys Gly Leu Gly Leu Asn Ala Tyr Arg Ile Gly Ile Glu Trp Ser

AGA ATC TTT CCC TGG CCG ACG TGG ACG GTC GAT ACC GAG GTC GAG TTC GAC

Arg Ile Phe Pro Trp Pro Thr Trp Thr Val Asp Thr Glu Val Glu Phe Asp

ACT TAC GGT TTA GTA AAG GAC GTT AAG ATA GAC AAG TCC ACC CTT GCT GAA

Thr Tyr Gly Leu Val Lys Asp Val Lys Ile Asp Lys Ser Thr Leu Ala Glu

CTC GAC AGG CTG GCC AAC AAG GAG GAG GTA ATG TAC TAC AGG CGC GTT ATT
Leu Asp Arg Leu Ala Asn Lys Glu Glu Val Met Tyr Tyr Arg Arg Val Ile

CAG CAT TTG AGG GAG CTC GGC TTC AAG GTC TTC GTT AAC CTC AAC CAC TTC
Gln His Leu Arg Glu Leu Gly Phe Lys Val Phe Val Asn Leu Asn His Phe

ACG CTT CCA ATA TGG CTC CAC GAC CCG ATA GTG GCA AGG GAG AAG GCC CTC
Thr Leu Pro Ile Trp Leu His Asp Pro Ile Val Ala Arg Glu Lys Ala Leu

ACA AAC GAC AGA ATC GGC TGG GTC TCC CAG AGG ACA GTT GTT GAG TTT GCC
Thr Asn Asp Arg Ile Gly Trp Val Ser Gln Arg Thr Val Val Glu Phe Ala

AAG TAT GCT GCT TAC ATC GCC CAT GCG CTC GGA GAC CTC GTG GAC ACA TGG
Lys Tyr Ala Ala Tyr Ile Ala His Ala Leu Gly Asp Leu Val Asp Thr Trp

AGC ACC TTC AAC GAA CCT ATG GTA GTT GTG GAG CTC GGC TAC CTC GCC CCC
Ser Thr Phe Asn Glu Pro Met Val Val Val Glu Leu Gly Tyr Leu Ala Pro

TAC TCA GGA TTT CCC CCG GGA GTC ATG AAC CCC GAG GCC GCG AAG CTG GCG
Tyr Ser Gly Phe Pro Pro Gly Val Met Asn Pro Glu Ala Ala Lys Leu Ala

ATC CTC AAC ATG ATA AAC GCC CAC GCC TTG GCA TAT AAG ATG ATA AAG AGG
Ile Leu Asn Met Ile Asn Ala His Ala Leu Ala Tyr Lys Met Ile Lys Arg

59/121

TTC GAC ACC AAG AAG GCC GAT GAG GAT AGC AAG TCC CCT GCG GAC GTT GGC
Phe Asp Thr Lys Lys Ala Asp Glu Asp Ser Lys Ser Pro Ala Asp Val Gly

ATA ATC TAC AAC AAC ATC GGT GTT GCC TAC CCT AAA GAC CCT AAC GAT CCC
Ile Ile Tyr Asn Asn Ile Gly Val Ala Tyr Pro Lys Asp Pro Asn Asp Pro

AAG GAC GTT AAA GCA GCC GAA AAC GAC AAC TAC TTC CAC AGC GGA CTG TTC
Lys Asp Val Lys Ala Ala Glu Asn Asp Asn Tyr Phe His Ser Gly Leu Phe

TTT GAT GCC ATC CAC AAG GGT AAG CTC AAC ATA GAG TTC GAC GGC GAA AAC
Phe Asp Ala Ile His Lys Gly Lys Leu Asn Ile Glu Phe Asp Gly Glu Asn

TTT GTA AAA GTT AGA CAC CTA AAA GGC AAT GAC TGG ATA GGC CTC AAC TAC
Phe Val Lys Val Arg His Leu Lys Gly Asn Asp Trp Ile Gly Leu Asn Tyr

TAC ACC CGC GAG GTT GTT AGA TAT TCG GAG CCC AAG TTC CCA AGT ATA CCC
Tyr Thr Arg Glu Val Val Arg Tyr Ser Glu Pro Lys Phe Pro Ser Ile Pro

CTC ATA TCC TTC AAG GGC GTT CCC AAC TAC GGC TAC TCC TGC AGG CCC GGC
Leu Ile Ser Phe Lys Gly Val Pro Asn Tyr Gly Tyr Ser Cys Arg Pro Gly

ACG ACC TCC GCC GAT GGC ATG CCC GTC AGC GAT ATC GGC TGG GAA GTC TAT

Thr Thr Ser Ala Asp Gly Met Pro Val Ser Asp Ile Gly Trp Glu Val Tyr

CCC CAG GGA ATC TAC GAC TCG ATA GTC GAG GCC ACC AAG TAC AGT GTT CCT

Pro Gln Gly Ile Tyr Asp Ser Ile Val Glu Ala Thr Lys Tyr Ser Val Pro

GTT TAC GTC ACC GAG AAC GGT GTT GCG GAT TCC GCG GAC ACG CTG AGG CCA

Val Tyr Val Thr Glu Asn Gly Val Ala Asp Ser Ala Asp Thr Leu Arg Pro

TAC TAC ATA GTC AGC CAC GTC TCA AAG ATA GAG GAA GCC ATT GAG AAT GGA

Tyr Tyr Ile Val Ser His Val Ser Lys Ile Glu Glu Ala Ile Glu Asn Gly

TAC CCC GTA AAA GGC TAC ATG TAC TGG GCG CTT ACG GAT AAC TAC GAG TGG

Tyr Pro Val Lys Gly Tyr Met Tyr Trp Ala Leu Thr Asp Asn Tyr Glu Trp

GCC CTC GGC TTC AGC ATG AGG TTT GGT CTC TAC AAG GTC GAC CTC ATC TCC

Ala Leu Gly Phe Ser Met Arg Phe Gly Leu Tyr Lys Val Asp Leu Ile Ser

AAG GAG AGG ATC CCG AGG GAG AGA AGC GTT GAG ATA TAT CGC AGG ATA GTG

Lys Glu Arg Ile Pro Arg Glu Arg Ser Val Glu Ile Tyr Arg Arg Ile Val

CAG TCC AAC GGT GTT CCT AAG GAT ATC AAA GAG GAG TTC CTG AAG GGT GAG

Gln Ser Asn Gly Val Pro Lys Asp Ile Lys Glu Glu Phe Leu Lys Gly Glu

GAG AAA TGA

1538

Glu Lys END

Figure 1M

(SEQ ID NO:25 - nucleotide sequence and SEQ ID NO:26 - amino acid sequence)
AEPH 1a (Clone # 63GB1) Glycosidase

1

ATG CTA CCA GAA GAG TTC CTA TGG GGC GTT GGG CAG TCA GGC TTT CAG TTC

Met Leu Pro Glu Glu Phe Leu Trp Gly Val Gly Gln Ser Gly Phe Gln Phe

GAA ATG GGC GAC AAG CTC AGG AGG CAC ATC GAT CCA AAT ACC GAC TGG TGG

Glu Met Gly Asp Lys Leu Arg Arg His Ile Asp Pro Asn Thr Asp Trp Trp

AAG TGG GTT CGC GAT CCT TTC AAC ATA AAA AAG GAG CTT GTG AGT GGG GAC

Lys Trp Val Arg Asp Pro Phe Asn Ile Lys Lys Glu Leu Val Ser Gly Asp

CTT CCC GAG GAC GGC ATC AAC AAC TAC GAA CTT TTT GAA AAC GAT CAC AAG

Leu Pro Glu Asp Gly Ile Asn Asn Tyr Glu Leu Phe Glu Asn Asp His Lys

CTC GCT AAA GGC CTT GGA CTC AAC GCA TAC GGG ATT GGA ATA GAG TGG AGC

Leu Ala Lys Gly Leu Gly Leu Asn Ala Tyr Gly Ile Gly Ile Glu Trp Ser

AGA ATC TTT CCC TGG CCG ACG TGG ACG GTC GAT ACC GAG GTC GAG TTC GAC

Arg Ile Phe Pro Trp Pro Thr Trp Thr Val Asp Thr Glu Val Glu Phe Asp

ACT TAC GGT TTA GTA AAG GAC GTT AAG ATA GAC AAG TCC ACC CTT GCT GAA

Thr Tyr Gly Leu Val Lys Asp Val Lys Ile Asp Lys Ser Thr Leu Ala Glu

63/121

CTC GAC AGG CTG GCC AAC AAG GAG GAG GTA ATG TAC TAC AGG CGC GTT ATT

Leu Asp Arg Leu Ala Asn Lys Glu Glu Val Met Tyr Tyr Arg Arg Val Ile

CAG CAT TTG AGG GAG CTC GGC TTC AAG GTC TTC GTT AAC CTC AAC CAC TTC

Gln His Leu Arg Glu Leu Gly Phe Lys Val Phe Val Asn Leu Asn His Phe

ACG CTT CCA ATA TGG CTC CAC GAC CCG ATA GTG GCA AGG GAG AAG GCC CTC

Thr Leu Pro Ile Trp Leu His Asp Pro Ile Val Ala Arg Glu Lys Ala Leu

ACA AAC GAC AGA ATC GGC TGG GTC TCC CAG AGG ACA GTT GTT GAG TTT GCC

Thr Asn Asp Arg Ile Gly Trp Val Ser Gln Arg Thr Val Val Glu Phe Ala

AAG TAT GCT GCT TAC ATC GCC CAT GCG CTC GGA GAC CTC GTG GAC ACA TGG

Lys Tyr Ala Ala Tyr Ile Ala His Ala Leu Gly Asp Leu Val Asp Thr Trp

AGC ACC TTC AAC GAA CCT ATG GTA GTT GTG GAG CTC GGA TAC CTC GCC CCC

Ser Thr Phe Asn Glu Pro Met Val Val Val Glu Leu Gly Tyr Leu Ala Pro

TAC TCA GGA TTT CCC CCG GGA GTC ATG AAC CCC GAG GCC GCG AAG CTG GCG

Tyr Ser Gly Phe Pro Pro Gly Val Met Asn Pro Glu Ala Ala Lys Leu Ala

ATC CTC AAC ATG ATA AAC GCC CAC GCC TTG GCA TAT AAG ATG ATA AAG AGG

Ile Leu Asn Met Ile Asn Ala His Ala Leu Ala Tyr Lys Met Ile Lys Arg

64/121

TTC GAC ACC AAG AAG GCC GAT GAG GAT AGC AAG TCC CCT GCG GAC GTT GGC
Phe Asp Thr Lys Lys Ala Asp Glu Asp Ser Lys Ser Pro Ala Asp Val Gly

ATA ATC TAC AAC AAC ATC GGT GTT GCC TAC CCT AAA GAC CCT AAC GAT CCC
Ile Ile Tyr Asn Asn Ile Gly Val Ala Tyr Pro Lys Asp Pro Asn Asp Pro

AAG GAC GTT AAA GCA GCC GAA AAC GAC AAC TAC TTC CAC AGC GGA CTG TTC
Lys Asp Val Lys Ala Ala Glu Asn Asp Asn Tyr Phe His Ser Gly Leu Phe

TTT GAT GCC ATC CAC AAG GGT AAG CTC AAC ATA GAG TTC GAC GGC GAA AAC
Phe Asp Ala Ile His Lys Gly Lys Leu Asn Ile Glu Phe Asp Gly Glu Asn

TTT GTA AAA GTT AGA CAC CTA AAA GGC AAT GAC TGG ATA GGC CTC AAC TAC
Phe Val Lys Val Arg His Leu Lys Gly Asn Asp Trp Ile Gly Leu Asn Tyr

TAC ACC CGC GAG GTT GTT AGA TAT TCG GAG CCC AAG TTC CCA AGT ATA CCC
Tyr Thr Arg Glu Val Val Arg Tyr Ser Glu Pro Lys Phe Pro Ser Ile Pro

CTC ATA TCC TTC AAG GGC GTT CCC AAC TAC GGC TAC TCC TGC AGG CCC GGC
Leu Ile Ser Phe Lys Gly Val Pro Asn Tyr Gly Tyr Ser Cys Arg Pro Gly

ACG ACC TCC GCC GAT GGC ATG CCC GTC AGC GAT ATC GGC TGG GAA GTC TAT

Thr Thr Ser Ala Asp Gly Met Pro Val Ser Asp Ile Gly Trp Glu Val Tyr

CCC CAG GGA ATC TAC GAC TCG ATA GTC GAG GCC ACC AAG TAC AGT GTT CCT

Pro Gln Gly Ile Tyr Asp Ser Ile Val Glu Ala Thr Lys Tyr Ser Val Pro

GTT TAC GTC ACC GAG AAC GGT GTT GCG GAT TCC GCG GAC ACG CTG AGG CCA

Val Tyr Val Thr Glu Asn Gly Val Ala Asp Ser Ala Asp Thr Leu Arg Pro

TAC TAC ATA GTC AGC CAC GTC TCA AAG ATA GAG GAA GCC ATT GAG AAT GGA

Tyr Tyr Ile Val Ser His Val Ser Lys Ile Glu Glu Ala Ile Glu Asn Gly

TAC CCC GTA AAA GGC TAC ATG TAC TGG GCG CTT ACG GAT AAC TAC GAG TGG

Tyr Pro Val Lys Gly Tyr Met Tyr Trp Ala Leu Thr Asp Asn Tyr Glu Trp

GCC CTC GGC TTC AGC ATG AGG TTT GGT CTC TAC AAG GTC GAC CTC ATC TCC

Ala Leu Gly Phe Ser Met Arg Phe Gly Leu Tyr Lys Val Asp Leu Ile Ser

AAG GAG AGG ATC CCG AGG GAG AGA AGC GTT GAG ATA TAT CGC AGG ATA GTG

Lys Glu Arg Ile Pro Arg Glu Arg Ser Val Glu Ile Tyr Arg Arg Ile Val

CAG TCC AAC GGT GTT CCT AAG GAT ATC AAA GAG GAG TTC CTG AAG GGT GAG

Gln Ser Asn Gly Val Pro Lys Asp Ile Lys Glu Glu Phe Leu Lys Gly Glu

GAG AAA TGA

1538

Glu Lys END

Figure 1N

(SEQ ID NO:27 - nucleotide sequence and SEQ ID NO:28 - amino acid sequence)
AEP11 1a (Clone # 63GP1) Glycosidase

1

ATG CGT CCA TTC TTG TTA ATT TCT ATT TTG GAC TTT CGA GTT GCT GAC TAC

Met Arg Pro Phe Leu Leu Ile Ser Ile Leu Asp Phe Arg Val Ala Asp Tyr

CTC CAA CGT AAC ATA AAG ACA CAA AAC CAA TAT TGG GCA TTG TGC GTA GTA

Leu Gln Arg Asn Ile Lys Thr Gln Asn Gln Tyr Trp Ala Leu Cys Val Val

ATG TTC TCC AAT GTT CTT AGA TGG CAA AAC TTA AAT ATT TCA CCA GCG GTG

Met Phe Ser Asn Val Leu Arg Trp Gln Asn Leu Asn Ile Ser Pro Ala Val

ATA CAT AGA GAC ACC GCT GAA CAC AGA GGT GAT TCC ATG AAG AAG TTT GTC

Ile His Arg Asp Thr Ala Glu His Arg Gly Asp Ser Met Lys Lys Phe Val

GCC CTG TTC ATA ACC ATG TTT TTC GTA GTG AGC ATG GCA GTC GTT GCA CAG

Ala Leu Phe Ile Thr Met Phe Phe Val Val Ser Met Ala Val Val Ala Gln

CCA GCT AGC GCC GCA AAG TAT TCC GAG CTC GAA GAA GGC GGC GTT ATA ATG

Pro Ala Ser Ala Ala Lys Tyr Ser Glu Leu Glu Glu Gly Gly Val Ile Met

CAG GCC TTC TAC TGG GAC GTC CCA GGT GGA GGA ATC TGG TGG GAC ACC ATC

Gln Ala Phe Tyr Trp Asp Val Pro Gly Gly Gly Ile Trp Trp Asp Thr Ile

68/121

AGG AGC AAG ATA CCG GAG TGG TAC GAG GCG GGA ATA TCC GCC ATT TGG ATT
Arg Ser Lys Ile Pro Glu Trp Tyr Glu Ala Gly Ile Ser Ala Ile Trp Ile

CCG CCA GCC AGC AAG GGG ATG AGC GGC GGT TAC TCG ATG GGC TAC GAT CCC
Pro Pro Ala Ser Lys Gly Met Ser Gly Gly Tyr Ser Met Gly Tyr Asp Pro

TAC GAT TTC TTT GAC CTC GGC GAG TAC AAC CAG AAG GGA ACC ATC GAA ACG
Tyr Asp Phe Phe Asp Leu Gly Glu Tyr Asn Gln Lys Gly Thr Ile Glu Thr

CGC TTT GGC TCT AAA CAG GAG CTC ATC AAT ATG ATA AAC ACG GCC CAT GCC
Arg Phe Gly Ser Lys Gln Glu Leu Ile Asn Met Ile Asn Thr Ala His Ala

TAC GGC ATA AAG GTC ATA GCG GAC ATC GTC ATA AAC CAC CGC GCA GGC GGA
Tyr Gly Ile Lys Val Ile Ala Asp Ile Val Ile Asn His Arg Ala Gly Gly

GAC CTC GAG TGG AAC CCG TTC GTT GGG GAC TAC ACC TGG ACG GAC TTC TCA
Asp Leu Glu Trp Asn Pro Phe Val Gly Asp Tyr Thr Trp Thr Asp Phe Ser

AAG GTG GCC TCG GGC AAA TAT ACT GCC AAC TAC CTC GAC TTC CAC CCC AAC
Lys Val Ala Ser Gly Lys Tyr Thr Ala Asn Tyr Leu Asp Phe His Pro Asn

GAG GTC AAG TGC TGT GAC GAG GGC ACA TTT GGA GGC TTC CCA GAC ATA GCC
Glu Val Lys Cys Cys Asp Glu Gly Thr Phe Gly Gly Phe Pro Asp Ile Ala

69/121

CAC GAG AAG AGC TGG GAC CAG CAC TGG CTC TGG GCG AGC GAT GAG AGC TAC
His Glu Lys Ser Trp Asp Gln His Trp Leu Trp Ala Ser Asp Glu Ser Tyr

GCC GCC TAC CTA AGG AGC ATC GGC GTT GAT GCC TGG CGC TTT GAC TAC GTG
Ala Ala Tyr Leu Arg Ser Ile Gly Val Asp Ala Trp Arg Phe Asp Tyr Val

AAG GGC TAC GGA GCG TGG GTC GTC AAG GAC TGG CTC AAC TGG TGG GGC GGC
Lys Gly Tyr Gly Ala Trp Val Val Lys Asp Trp Leu Asn Trp Trp Gly Gly

TGG GCC GTT GGC GAG TAC TGG GAC ACC AAC GTT GAT GCA CTC CTC AAC TGG
Trp Ala Val Gly Glu Tyr Trp Asp Thr Asn Val Asp Ala Leu Leu Asn Trp

GCC TAC TCG AGC GGC GCC AAG GTC TTC GAC TTC CCG CTC TAC TAC AAG ATG
Ala Tyr Ser Ser Gly Ala Lys Val Phe Asp Phe Pro Leu Tyr Tyr Lys Met

GAT GAG GCC TTT GAC AAC AAA AAC ATT CCA GCG CTC GTC TCT GCC CTT CAG
Asp Glu Ala Phe Asp Asn Lys Asn Ile Pro Ala Leu Val Ser Ala Leu Gln

AAC GGC CAG ACT GTT GTC TCC CGC GAC CCG TTC AAG GCC GTA ACC TTT GTA
Asn Gly Gln Thr Val Val Ser Arg Asp Pro Phe Lys Ala Val Thr Phe Val

GCA AAC CAC GAC ACC GAT ATA ATC TGG AAC AAG TAC CTT GCT TAT GCT TTC

70/121

Ala Asn His Asp Thr Asp Ile Ile Trp Asn Lys Tyr Leu Ala Tyr Ala Phe

ATC CTC ACC TAC GAA GGC CAG CCC GTC ATA TTT TAC CGC GAC TAC GAG GAG

Ile Leu Thr Tyr Glu Gly Gln Pro Val Ile Phe Tyr Arg Asp Tyr Glu Glu

TGG CTC AAC AAG GAC AGG TTG AAC AAC CTC ATA TGG ATA CAC GAC CAC CTC

Trp Leu Asn Lys Asp Arg Leu Asn Asn Leu Ile Trp Ile His Asp His Leu

GCA GGT GGA AGC ACG AGC ATA GTT TAC TAC GAC AGC GAC GAG ATG ATT TTC

Ala Gly Gly Ser Thr Ser Ile Val Tyr Tyr Asp Ser Asp Glu Met Ile Phe

GTG AGG AAC GGC TAT GGA AGC AAG CCT GGC CTT ATA ACT TAC ATC AAC CTC

Val Arg Asn Gly Tyr Gly Ser Lys Pro Gly Leu Ile Thr Tyr Ile Asn Leu

GGC TCG AGC AAG GTT GGA AGG TGG GTT TAT GTG CCG AAG TTC GCG GGC GCG

Gly Ser Ser Lys Val Gly Arg Trp Val Tyr Val Pro Lys Phe Ala Gly Ala

TGC ATC CAC GAG TAT ACT GGT AAC CTC GGA GGC TGG GTA GAC AAG TAC GTC

Cys Ile His Glu Tyr Thr Gly Asn Leu Gly Gly Trp Val Asp Lys Tyr Val

TAC TCA AGC GGC TGG GTC TAT TTC GAA GCT CCA GCT TAC GAC CCT GCC AAC

Tyr Ser Ser Gly Trp Val Tyr Phe Glu Ala Pro Ala Tyr Asp Pro Ala Asn

71/121

GGG CAG TAT GGC TAC TCC GTG TGG AGC TAT TGC GGT GTT GGG TGA 1574

Gly Gln Tyr Gly Tyr Ser Val Trp Ser Tyr Cys Gly Val Gly END

Figure 10

(SEQ ID NO:29 - nucleotide sequence and SEQ ID NO:30 - amino acid sequence)
AEPII 1a (Clone # 63GP2) Glycosidase

1

ATG ATA AAC GTT GCA ACG GGA GAG GAG ACC CCA ATA CAC CTC TTT GGA GTC

Met Ile Asn Val Ala Thr Gly Glu Glu Thr Pro Ile His Leu Phe Gly Val

AAC TGG TTC GGC TTT GAG ACA CCG AAC TAC GTT GTT CAC GGC CTA TGG AGT

Asn Trp Phe Gly Phe Glu Thr Pro Asn Tyr Val Val His Gly Leu Trp Ser

AGG AAC TGG GAG GAC ATG CTC CTC CAG ATC AAG AGC CTT GGC TTC AAT GCG

Arg Asn Trp Glu Asp Met Leu Leu Gln Ile Lys Ser Leu Gly Phe Asn Ala

ATA AGG CTT CCC TTC TGT ACC CAG TCA GTA AAA CCG GGG ACG ATG CCA ACG

Ile Arg Leu Pro Phe Cys Thr Gln Ser Val Lys Pro Gly Thr Met Pro Thr

GCG ATT GAC TAC GCC AAG AAC CCA GAC CTC CAG GGT CTT GAC AGC GTC CAG

Ala Ile Asp Tyr Ala Lys Asn Pro Asp Leu Gln Gly Leu Asp Ser Val Gln

ATA ATG GAG AAA ATA ATC AAG AAG GCT GGA GAC CTG GGC ATA TTC GTG CTC

Ile Met Glu Lys Ile Ile Lys Lys Ala Gly Asp Leu Gly Ile Phe Val Leu

CTC GAC TAC CAC AGA ATA GGA TGC AAC TTC ATA GAA CCC CTA TGG TAC ACC

Leu Asp Tyr His Arg Ile Gly Cys Asn Phe Ile Glu Pro Leu Trp Tyr Thr

73/121

GAC AGC TTC TCG GAG CAG GAC TAC ATA AAC ACC TGG GTT GAA GTC GCC CAG
Asp Ser Phe Ser Glu Gln Asp Tyr Ile Asn Thr Trp Val Glu Val Ala Gln

AGG TTC GGC AAG TAC TGG AAC GTT ATC GGC GCG GAC CTG AAG AAC GAA CCC
Arg Phe Gly Lys Tyr Trp Asn Val Ile Gly Ala Asp Leu Lys Asn Glu Pro

CAC AGC TCA AGC CCC GCA CCT GCC GCC TAC ACT GAC GGA AGT GGG GCC ACG
His Ser Ser Ser Pro Ala Pro Ala Ala Tyr Thr Asp Gly Ser Gly Ala Thr

TGG GGA ATG GGC AAC AAC GCC ACC GAC TGG AAC CTG GCG GCT GAG AGG ATA
Trp Gly Met Gly Asn Asn Ala Thr Asp Trp Asn Leu Ala Ala Glu Arg Ile

GGA AGG GCA ATT CTG GAG GTT GCC CCA CAA TGG GTT ATA TTT GTT GAG GGA
Gly Arg Ala Ile Leu Glu Val Ala Pro Gln Trp Val Ile Phe Val Glu Gly

ACC CAG TTC ACC ACC CCC GAG ATA GAC GGT AGG TAC AAG TGG GGC CAC AAC
Thr Gln Phe Thr Thr Pro Glu Ile Asp Gly Arg Tyr Lys Trp Gly His Asn

GCC TGG TGG GGC GGA AAC CTT ATG GGT GTT AGG AAG TAC CCA GTT AAC CTG
Ala Trp Trp Gly Gly Asn Leu Met Gly Val Arg Lys Tyr Pro Val Asn Leu

CCC AGG GAC AAG CTT GTT TAC AGC CCC CAA GTT TAC GGT CCA GAC GTT TAC
Pro Arg Asp Lys Leu Val Tyr Ser Pro Gln Val Tyr Gly Pro Asp Val Tyr

74/121

GAC CAG CCC TAC TTT GAC CCC GGT GAG GGG TTC CCC GAC AAC CTC CCC GAA
Asp Gln Pro Tyr Phe Asp Pro Gly Glu Gly Phe Pro Asp Asn Leu Pro Glu

ATA TGG TAC CAC CAC TTC GGC TAC GTA AAG CTT GAT CTC GGT TAC CCT GTT
Ile Trp Tyr His His Phe Gly Tyr Val Lys Leu Asp Leu Gly Tyr Pro Val

GTT ATA GGT GAG TTC GGA GGC AAG TAC GGC CAT GGG GGA GAC CCG AGG GAT
Val Ile Gly Glu Phe Gly Gly Lys Tyr Gly His Gly Gly Asp Pro Arg Asp

GTC ACT TGG CAG AAC AAG ATA ATA GAC TGG ATG ATC CAG AAC AAA TTC TGT
Val Thr Trp Gln Asn Lys Ile Ile Asp Trp Met Ile Gln Asn Lys Phe Cys

GAC TTC TTC TAC TGG AGC TGG AAC CCA AAC AGC GGT GAC ACC GGT GGA ATT
Asp Phe Phe Tyr Trp Ser Trp Asn Pro Asn Ser Gly Asp Thr Gly Gly Ile

CTG AAG GAT GAC TGG ACG ACA ATA TGG GAG GAC AAG TAC AAC AAC CTG AAG
Leu Lys Asp Asp Trp Thr Thr Ile Trp Glu Asp Lys Tyr Asn Asn Leu Lys

AGG CTC ATG GAC AGC TGT TCT GGA AAC GCC ACT GCC CCG TCC GTC CCC ACG
Arg Leu Met Asp Ser Cys Ser Gly Asn Ala Thr Ala Pro Ser Val Pro Thr

ACA ACT ACA ACA ACA AGC ACA CCG CCA ACG ACC ACA ACG ACT ACA ACA TCC

Thr Thr Thr Thr Thr Ser Thr Pro Pro Thr Thr Thr Thr Thr Thr Thr Ser

ACT CCA ACG ACC ACT ACC CAG ACC CCG ACC ACC ACT ACT CCA ACT ACG ACA

Thr Pro Thr Thr Thr Thr Gln Thr Pro Thr Thr Thr Thr Thr Pro Thr Thr Thr

ACC ACC ACG ACC ACA ACT CCT TCA AAT AAC GTC CCA TTT GAA ATT GTG AAC

Thr Thr Thr Thr Thr Thr Pro Ser Asn Asn Val Pro Phe Glu Ile Val Asn

GTT CTC CCG ACT AGC TCC CAG TAC GAG GGA ACC AGC GTG GAG GTT GTA TGT

Val Leu Pro Thr Ser Ser Gln Tyr Glu Gly Thr Ser Val Glu Val Val Cys

GAT GGA ACC CAG TGT GCC TCC AGC GTT TGG GGA GCT CCG AAC CTC TGG GGA

Asp Gly Thr Gln Cys Ala Ser Ser Val Trp Gly Ala Pro Asn Leu Trp Gly

GTC GTT AAA ATC GGA AAC GCC ACC ATG GAC CCC AAC GTT TGG GGC TGG GAG

Val Val Lys Ile Gly Asn Ala Thr Met Asp Pro Asn Val Trp Gly Trp Glu

GAC GTT TAC AAG ACT GCA CCC CAG GAC ATT GGA ACC GGC AGC ACA AAG ATG

Asp Val Tyr Lys Thr Ala Pro Gln Asp Ile Gly Thr Gly Ser Thr Lys Met

GAG ATA AGG AAC GGG GTG CTC AAG GTT ACA AAC CTC TGG AAC ATC AAC ATG

Glu Ile Arg Asn Gly Val Leu Lys Val Thr Asn Leu Trp Asn Ile Asn Met

Figure 1P

(SEQ ID NO:31 - nucleotide sequence and SEQ ID NO:32 - amino acid sequence)
AEPII 1a (Clone # 63GP4) Glycosidase

1

GCT GGA GTG GGT GAG CAA CGG GAT AAC CTA CCA GAT ATT CCC CGA CAG GTT

Ala Gly Val Gly Glu Gln Arg Asp Asn Leu Pro Asp Ile Pro Arg Gln Val

CAA CAA CGG AAA CAG GAG CAA CGA TGC CCT AGC TTT GGA CCA CGA CGA GCT

Gln Gln Arg Lys Gln Glu Gln Arg Cys Pro Ser Phe Gly Pro Arg Arg Ala

AAT TCT GAA CCA GGT CAA TCC AGG CAA ACC AAT CCT CTC CAA CTG GAG CGA

Asn Ser Glu Pro Gly Gln Ser Arg Gln Thr Asn Pro Leu Gln Leu Glu Arg

CCC TAT AAC GCC CCT CCA CTG CTG CCA CCA GTA CTT CGG CGG CGA CAT AAA

Pro Tyr Asn Ala Pro Pro Leu Leu Pro Pro Val Leu Arg Arg Arg His Lys

GGG AAT AAC GGA GAA GCT CGA CTA CCT TCA GAG CCT AGG TGT TAC TAT AAT

Gly Asn Asn Gly Glu Ala Arg Leu Pro Ser Glu Pro Arg Cys Tyr Tyr Asn

CTA CCT CAA CCC GAT TTT CCT CTC GGG AAG CGC CCA CGG CTA CGA CAC CTA

Leu Pro Gln Pro Asp Phe Pro Leu Gly Lys Arg Pro Arg Leu Arg His Leu

CGA CTA CTA CCG GCT TGA CCC CAA GTT CGG GAC CGA GGA GGA GCT GAG AGA

Arg Leu Leu Pro Ala End Pro Gln Val Arg Asp Arg Gly Gly Ala Glu Arg

77/121

CAT CCG AAG TAT AAC ACA ATG GCA TAC CCG GAG GTC ATA TAC GGC GCC AAG

His Pro Lys Tyr Asn Thr Met Ala Tyr Pro Glu Val Ile Tyr Gly Ala Lys

CCT TGG GGC AAC CAG CCA ATA AAC GCT CCG AAC TTC GTG CTC CCG ATA AAG

Pro Trp Gly Asn Gln Pro Ile Asn Ala Pro Asn Phe Val Leu Pro Ile Lys

GTC TCC CAG CTT CCG AGG ATA CTC GTT GAC ACA AAG TAC ACG CTC GAA AAG

Val Ser Gln Leu Pro Arg Ile Leu Val Asp Thr Lys Tyr Thr Leu Glu Lys

AGC TTC CCG GGA AAC AAC TTC GCC TTT GAG GCC TGG CTC TTC AAG GAT GCC

Ser Phe Pro Gly Asn Asn Phe Ala Phe Glu Ala Trp Leu Phe Lys Asp Ala

AAC AAC ATG AGG GCA CCA GGC CAG GGG GAC TAC GAG AGG AAT TCC GCC GAT

Asn Asn Met Arg Ala Pro Gly Gln Gly Asp Tyr Glu Arg Asn Ser Ala Asp

ACT GAC GGG CTC CAG GAG TCG TCG CCA CCA ATC CCC ATA TGG AAA CCG TCG

Thr Asp Gly Leu Gln Glu Ser Ser Pro Pro Ile Pro Ile Trp Lys Pro Ser

1886

ATA AGC TTG CGG CCG CCA CCG CGG TGG AGC TCC AGC TTT TGT TCC CTT TAA

Ile Ser Leu Arg Pro Pro Pro Arg Trp Ser Ser Ser Phe Cys Ser Leu END

78/121

GTT CCT CGA TGA GGC ACA CAG GCG GGG AAT GAG GGT AAT TTT CGA TTT TGT
Val Pro Arg End Gly Thr Gln Ala Gly Asn Glu Gly Asn Phe Arg Phe Cys

GCC CAA CCA CTG CGG CAT AGG GAA TCC AGC CTT CCT AGA AGT TTG GAA GAA
Ala Gln Pro Leu Arg His Arg Glu Ser Ser Leu Pro Arg Ser Leu Glu Glu

GGG CAA CGA AAG CCC ATA CTG GGA CTG GTT CTT CGT CAA GAA GTG GCC GTT
Gly Gln Arg Lys Pro Ile Leu Gly Leu Val Leu Arg Gln Glu Val Ala Val

CAA GCT CGG CGA TGG GAA CGC CTA CGT CGG CTG GTG GGG CTT TGG GAG CCT
Gln Ala Arg Arg Trp Glu Arg Leu Arg Arg Leu Val Gly Leu Trp Glu Pro

TCC AAA GCT CAA CAC TGC CAA CCC GGA GGT CAG GGA ATA CCT GAT AGG AGC
Ser Lys Ala Gln His Cys Gln Pro Gly Gly Gln Gly Ile Pro Asp Arg Ser

GGC CCT CCA CTG GAT AGA GTT CGG CTT TGA CGG CAT CAG GGT TGA TGT GCC
Gly Pro Pro Leu Asp Arg Val Arg Leu End Arg His Gln Gly End Cys Ala

GAA CGA AGT CCT CGA CCC GGG AAC GTT CTT CCC GGA GCT GAG AAA GGC AGT
Glu Arg Ser Pro Arg Pro Gly Asn Val Leu Pro Gly Ala Glu Lys Gly Ser

CAA GGA GAA AAA GCC GGA CGC ATA CCT CGT CGG TGA GAT ATG GAC GCT CTC
Gln Gly Glu Lys Ala Gly Arg Ile Pro Arg Arg End Asp Met Asp Ala Leu

79/121

CCC TGA GTG GGT GAA AGG AGA CCG CTT CGA CTC CCT CAT GAA CTA CGC CCT

Pro End Val Gly Glu Arg Arg Pro Leu Arg Leu Pro His Glu Leu Arg Pro

CGG GAG GGA CAT CCT CCT GAA CTA CGC GAA GGG CCT GCT CAG TGG AGA AAG

Arg Glu Gly His Pro Pro Glu Leu Arg Glu Gly Pro Ala Gln Trp Arg Lys

TGC AAT GAA AAT GAT GGG ACG TTA CTA TGC TTC CTA CGG CGA GAA CGT ATT

Cys Asn Glu Asn Asp Gly Thr Leu Leu Cys Phe Leu Arg Arg Glu Arg Ile

GCG ATG GGC TTC AAC CTC GTT GAT TCG CAC GAC ACT TCG AGG GTT CTC ACT

Ala Met Gly Phe Asn Leu Val Asp Ser His Asp Thr Ser Arg Val Leu Thr

GAT CTC GGT GGG GGG AGT CTC GGT GAC ACA CCG TCA AAC GAG TCA ATT CAG

Asp Leu Gly Gly Gly Ser Leu Gly Asp Thr Pro Ser Asn Glu Ser Ile Gln

AGA CTC AAG CTC CTC TCA ACG TCC TCT ATG CCC TGC CTG GAA CTC CGG TCA

Arg Leu Lys Leu Leu Ser Thr Ser Ser Met Pro Cys Leu Glu Leu Arg Ser

CCT TCC AGG GGA TGA GAG AGG ACT GCT CGG AGA CAA GGG GCA CTA CGA CGA

Pro Ser Arg Gly End Glu Arg Thr Ala Arg Arg Gln Gly Ala Leu Arg Arg

ACA GCG CTA CCC AAT ACA GTG GGA TAC TGT GAA CGA AGA CGT CCT GAA CCA

80/121

Thr Ala Leu Pro Asn Thr Val Gly Tyr Cys Glu Arg Arg Arg Pro Glu Pro

TTA CAG GGC ATT GGC GGA GCT CAG AAA AAG AGT TCC TGC ATT GAG GAG CAG

Leu Gln Gly Ile Gly Gly Ala Gln Lys Lys Ser Ser Cys Ile Glu Glu Gln

CGC AAT AAG GTT CTA CAC TGC CAA AGG CGG CGT TAT GGC CTT CTT CAG GGG

Arg Asn Lys Val Leu His Cys Gln Arg Arg Arg Tyr Gly Leu Leu Gln Gly

GCA TCA TGA CGA GGT TCT TGT CGT TGC CAA CAG CTG GAA GAA GCC AGC CCT

Ala Ser End Arg Gly Ser Cys Arg Cys Gln Gln Leu Glu Glu Ala Ser Pro

ACT AAA GCT TCC TGA GGG AGA GTG GAA AGT AAT CTG GCC TGA GAA TTT CAG

Thr Lys Ala Ser End Gly Arg Val Glu Ser Asn Leu Ala End Glu Phe Gln

CCC GGA ACT GCT TCG CGG CAA AGT TGA AGT GCC AGC CAT AGG GAT AAT CAT

Pro Gly Thr Ala Ser Arg Gln Ser End Ser Ala Ser His Arg Asp Asn His

CCT TGA GCG GAG TTG

1443

Pro End Ala Glu Leu

Figure 1Q

(SEQ ID NO:33 - nucleotide sequence and SEQ ID NO:34 - amino acid sequence)
Bacillus thermoloeovorans (Clone # 68GC1) Glycosidase

1

ATG ACT GAA TTA TAT ATA AAA AAT CCC CTG ATC GAA CAG CGG GCA GAT CCC

Met Thr Glu Leu Tyr Ile Lys Asn Pro Leu Ile Glu Gln Arg Ala Asp Pro

TGG ATC TAT AAA CAT ACC GAT GGT TAT TAT TAC TTT ACC GGT TCC GTG CCG

Trp Ile Tyr Lys His Thr Asp Gly Tyr Tyr Tyr Phe Thr Gly Ser Val Pro

GAG TAC GAC CGA ATT GAG CTT AGA CGC TCG CAA ACG ATT CAA GGG CTT GCG

Glu Tyr Asp Arg Ile Glu Leu Arg Arg Ser Gln Thr Ile Gln Gly Leu Ala

GAT GCC GAA GGA ATT ACG ATC TGG CGC AAG CAT GAG TCA GGC CTG ATG AGT

Asp Ala Glu Gly Ile Thr Ile Trp Arg Lys His Glu Ser Gly Leu Met Ser

GCC AAC ATA TGG GCA CCC GAG ATT CAT TAT ATG GAT GGC AAA TGG TAT GTG

Ala Asn Ile Trp Ala Pro Glu Ile His Tyr Met Asp Gly Lys Trp Tyr Val

TAT TAC GCC GCT GCC CAT ACT TCA GAA ACG AGG GAC GGA TTG TTC GAT CAC

Tyr Tyr Ala Ala Ala His Thr Ser Glu Thr Arg Asp Gly Leu Phe Asp His

CGC ATG TTC GTA TTG GAG AAC GCT TCG GCG AAC CCG CTC GAA GGG GAA TGG

Arg Met Phe Val Leu Glu Asn Ala Ser Ala Asn Pro Leu Glu Gly Glu Trp

82/121

GTG GAG AAG GGG CAA GTG ATC ACG AAG TGG GAA TCT TTC GCC TTG GAC GCA
Val Glu Lys Gly Gln Val Ile Thr Lys Trp Glu Ser Phe Ala Leu Asp Ala

ACG ACG TTC GAG CAT AAA GGC AAA CGG TAC TAT GTA TGG GCT CAG AAA GAT
Thr Thr Phe Glu His Lys Gly Lys Arg Tyr Tyr Val Trp Ala Gln Lys Asp

CCG GGC ATT CCA GGC AAT TCC AAT CTG TAT ATC TCA TTG ATG GAA GAC CCG
Pro Gly Ile Pro Gly Asn Ser Asn Leu Tyr Ile Ser Leu Met Glu Asp Pro

TGG ACC CTG ACA GGG GAA CAG GTA TGC ATA TCG GTT CCC GAG TAC GAT TGG
Trp Thr Leu Thr Gly Glu Gln Val Cys Ile Ser Val Pro Glu Tyr Asp Trp

GAG AAG ATC GGG TAT CTT GTG AAT GAA GGG GCC GCC GTT CTT AAG CGA AAC
Glu Lys Ile Gly Tyr Leu Val Asn Glu Gly Ala Ala Val Leu Lys Arg Asn

GGG CGA ATA TTC ATG ACC TAT TCC GCG AGC GCC ACG GAC CAC AAC TAT GCG
Gly Arg Ile Phe Met Thr Tyr Ser Ala Ser Ala Thr Asp His Asn Tyr Ala

ATG GGG CTG CTG ACA GCC GAT GAA GAC AGT GAT TTG CTG AAT CCG AGC TCC
Met Gly Leu Leu Thr Ala Asp Glu Asp Ser Asp Leu Leu Asn Pro Ser Ser

TGG GTC AAG TCG CCT GTA CCT GTA TTT ACG ACA TCT GAA GCC AAT GGC CAA
Trp Val Lys Ser Pro Val Pro Val Phe Thr Thr Ser Glu Ala Asn Gly Gln

83/121

TAT GGT CCG GGG CAC AAC AGC TTC ACG ATT TCC GAG GAC GGC TTG CAG GAC

Tyr Gly Pro Gly His Asn Ser Phe Thr Ile Ser Glu Asp Gly Leu Gln Asp

ATT TTG GTA TAC CAT GCA AGA AGT TAC AAG GAG ATC GTC GGG ATC CAC TAT

Ile Leu Val Tyr His Ala Arg Ser Tyr Lys Glu Ile Val Gly Ile His Tyr

ATG ATC CGA ACC GTC ATA CGC GTG TAC AGG TCA TCC GAT GGA ACG AAG ACG

Met Ile Arg Thr Val Ile Arg Val Tyr Arg Ser Ser Asp Gly Thr Lys Thr

GAA CGC CGA ATT TCG GGG TGC CAA GAG CGG ATC ATG AAC CGG TCT CCA AGC

Glu Arg Arg Ile Ser Gly Cys Gln Glu Arg Ile Met Asn Arg Ser Pro Ser

CAT GAT GCC GAC TTT GTC ATT GGG GTT GTG ACC GGA AGG ATT AAC AAA CAT

His Asp Ala Asp Phe Val Ile Gly Val Val Thr Gly Arg Ile Asn Lys His

CAG ACC GAC TGA 1031

Gln Thr Asp END

Figure 1R

(SEQ ID NO:35 - nucleotide sequence and SEQ ID NO:36 - amino acid sequence)
Thermotoga maritima (Clone # 6GA2) Glycosidase

1
TTG AAT AAC ACC ATT CCA AGA TGG CGT GGT TTC AAC CTT CTG GAG GCC TTT
Leu Asn Asn Thr Ile Pro Arg Trp Arg Gly Phe Asn Leu Leu Glu Ala Phe

TCC ATT AAA AGT ACA GGA AAT TTT AAA GAG GAA GAT TTT TTG TGG ATG GCT
Ser Ile Lys Ser Thr Gly Asn Phe Lys Glu Glu Asp Phe Leu Trp Met Ala

CAG TGG GAC TTT AAT TTT GTT AGA ATC CCT ATG TGT CAT CTT CTC TGG TCA
Gln Trp Asp Phe Asn Phe Val Arg Ile Pro Met Cys His Leu Leu Trp Ser

GAC CGG GGC AAC CCA TTT ATT ATC AGA GAA GAT TTT TTT GAG AAA ATC GAT
Asp Arg Gly Asn Pro Phe Ile Ile Arg Glu Asp Phe Phe Glu Lys Ile Asp

CGT GTA ATT TTC TGG GGA GAG AAA TAT GGA ATA CAT ATA TGT ATT TCT CTT
Arg Val Ile Phe Trp Gly Glu Lys Tyr Gly Ile His Ile Cys Ile Ser Leu

CAC AGG GCA CCT GGC TAT TCT GTT AAC AAG GAA GTA GAA GAG AAA ACC AAT
His Arg Ala Pro Gly Tyr Ser Val Asn Lys Glu Val Glu Glu Lys Thr Asn

CTG TGG AAA GAT GAA ACA GCT CAA GAA GCG TTC ATT CAT CAC TGG TCT TTT
Leu Trp Lys Asp Glu Thr Ala Gln Glu Ala Phe Ile His His Trp Ser Phe

85/121

ATC GCA CGT CGT TAC AAA GGA ATT TCT TCC ACA CAC CTG AGT TTT AAC TTA
Ile Ala Arg Arg Tyr Lys Gly Ile Ser Ser Thr His Leu Ser Phe Asn Leu

ATA AAT GAG CCT CCA TTT CCT GAT CCA CAA ATC ATG AGT GTT GAA GAT CAC
Ile Asn Glu Pro Pro Phe Pro Asp Pro Gln Ile Met Ser Val Glu Asp His

AAC TCT CTT ATC AAG AGA ACT ATT ACA GAA ATT CGA AAA ATA GAT CCC GAA
Asn Ser Leu Ile Lys Arg Thr Ile Thr Glu Ile Arg Lys Ile Asp Pro Glu

AGA TTA ATT ATA ATA GAT GGA TTA GGC TAT GGG AAT ATT CCA GTG GAT GAT
Arg Leu Ile Ile Ile Asp Gly Leu Gly Tyr Gly Asn Ile Pro Val Asp Asp

TTA ACA ATT GAG AAT ACA GTG CAA TCA TGC AGA GGG TAC ATT CCC TTC AGT
Leu Thr Ile Glu Asn Thr Val Gln Ser Cys Arg Gly Tyr Ile Pro Phe Ser

GTT ACT CAT TAC AAA GCG GAA TGG GTG GAT AGT AAG GAC TTT CCT GTT CCT
Val Thr His Tyr Lys Ala Glu Trp Val Asp Ser Lys Asp Phe Pro Val Pro

GAG TGG CCA AAT GGA TGG CAT TTT GGG GAA TAC TGG AAC AGA GAA AAG TTA
Glu Trp Pro Asn Gly Trp His Phe Gly Glu Tyr Trp Asn Arg Glu Lys Leu

TTG GAA CAT TAT TTA ACG TGG ATA AAA CTC AGA CAA AAA GGA ATA GAA GTA
Leu Glu His Tyr Leu Thr Trp Ile Lys Leu Arg Gln Lys Gly Ile Glu Val

86/121

TTC TGT GGA GAA ATG GGA GCT TAC AAC AAA ACA CCT CAC GAT GTG GTT TTA

Phe Cys Gly Glu Met Gly Ala Tyr Asn Lys Thr Pro His Asp Val Val Leu

AAA TGG CTT GAA GAT CTT TTA GAA ATT TTT AAA ACT TTG AAC ATA GGG TTT

Lys Trp Leu Glu Asp Leu Leu Glu Ile Phe Lys Thr Leu Asn Ile Gly Phe

GCC TTA TGG AAT TTT AGA GGT CCT TTT GGT ATT TTA GAT TCG GAA AGG AAA

Ala Leu Trp Asn Phe Arg Gly Pro Phe Gly Ile Leu Asp Ser Glu Arg Lys

GAC GTT GAA TAC GAA GAA TGG TAT GGA CAT AAA CTG GAT AGG AAA ATG TTG

Asp Val Glu Tyr Glu Glu Trp Tyr Gly His Lys Leu Asp Arg Lys Met Leu

GAA CTA TTG AGA AAA TAT TAG 990

Glu Leu Leu Arg Lys Tyr End

Figure 1S

(SEQ ID NO:37 - nucleotide sequence and SEQ ID NO:38 - amino acid sequence)
Thermotoga maritima MSB8 (Clone # 6GC17) Glycosidase

1

ATG CTC TCA GAG ATT GTT CCG TAT ACT GTT CTG AGA AGA GAA AGA ATA GAA

Met Leu Ser Glu Ile Val Pro Tyr Thr Val Leu Arg Arg Glu Arg Ile Glu

AGC TGG ATT TTC TCC GAT GAT GCT GTT GAG AGA ATC GTG GAT CCT TCC TTC

Ser Trp Ile Phe Ser Asp Asp Ala Val Glu Arg Ile Val Asp Pro Ser Phe

GAA TGG GAC TTC AGC TCC GCT CCC GTC CGG TTC AGG AAA GAG CTA GAG CCT

Glu Trp Asp Phe Ser Ser Ala Pro Val Arg Phe Arg Lys Glu Leu Glu Pro

TTC TCC GTC GCT GGA GAG CAG AGG GCC TAC CTG AAA CTC TGG TTC GGT GGT

Phe Ser Val Ala Gly Glu Gln Arg Ala Tyr Leu Lys Leu Trp Phe Gly Gly

GAA ACA CTC GTT CTG ATA GAT GGG AAG CCT TAC GGT GAG ATC AAC GAG TAT

Glu Thr Leu Val Leu Ile Asp Gly Lys Pro Tyr Gly Glu Ile Asn Glu Tyr

CAT AGG ATG TTG AAC ATC ACC CCC CTT GCT GAT GGA AAA CCA CAC ACG ATA

His Arg Met Leu Asn Ile Thr Pro Leu Ala Asp Gly Lys Pro His Thr Ile

GAA GCT CAG GTG ATG CCA AGG GGT CTC TTT GGA AAA CCA GAA AAG CCG GTG

Glu Ala Gln Val Met Pro Arg Gly Leu Phe Gly Lys Pro Glu Lys Pro Val

88/121

TTC ACG GAA GCT TTC TTC ATC GTC GTT GAT GAA GCA CTG ATG AAG GTG GTG
Phe Thr Glu Ala Phe Phe Ile Val Val Asp Glu Ala Leu Met Lys Val Val

AAA ACT CTC GAA CTC ACT ATA AAA ACG GCA GAA GTG ATA GAA GAC GAG TCG
Lys Thr Leu Glu Leu Thr Ile Lys Thr Ala Glu Val Ile Glu Asp Glu Ser

CTT TCT AAG AAA CTT CTG GAC ATC TCC GAG GAG TTT CTC TCG AAA GTA TGG
Leu Ser Lys Lys Leu Leu Asp Ile Ser Glu Glu Phe Leu Ser Lys Val Trp

ATC CCA AGA GAC ACA GGT ACC TAT CTG ATG ACA GCA CTG GAG GAT CCG GGA
Ile Pro Arg Asp Thr Gly Thr Tyr Leu Met Thr Ala Leu Glu Asp Pro Gly

ATA AAA GAT GAG ATC AAA AAC ACC TGG AAC ACA CCG GAG TTC AAA GAG TTC
Ile Lys Asp Glu Ile Lys Asn Thr Trp Asn Thr Pro Glu Phe Lys Glu Phe

ACA GGT GTG AAG CTT CCT GAA GAG TTG AGA AAT CAG ATT CTG GAA GAG TTC
Thr Gly Val Lys Leu Pro Glu Glu Leu Arg Asn Gln Ile Leu Glu Glu Phe

GAA AAA TTC AAA GAA AAG CTG GAT AGA ATA AGA AAA AAC CAT CCG GGT TTT
Glu Lys Phe Lys Glu Lys Leu Asp Arg Ile Arg Lys Asn His Pro Gly Phe

GGA ACG ATT CAC CTT GTG GGG CAC GCG CAC ATA GAC TAC GCC TGG CTC TGG
Gly Thr Ile His Leu Val Gly His Ala His Ile Asp Tyr Ala Trp Leu Trp

89/121

CCA GTT GAG GAG ACG AAG AGA AAG ATC CTA CGC ACT TTC GCA AAC TCT GTG
Pro Val Glu Glu Thr Lys Arg Lys Ile Leu Arg Thr Phe Ala Asn Ser Val

TTG CTC TCT AAG CTT TAT CCG GAG TTC GTT TAC ACT CAG TCT TCT GCT CAG
Leu Leu Ser Lys Leu Tyr Pro Glu Phe Val Tyr Thr Gln Ser Ser Ala Gln

ATG TAC GAG GAT CTC AAG CAA AAT TCA CCA GAG CTT TTC GAG GAA GTG AGA
Met Tyr Glu Asp Leu Lys Gln Asn Ser Pro Glu Leu Phe Glu Glu Val Arg

AAG CTC GTA GAA GAG GGG AGA TGG GAG CCA GTC GGT GGC ATG TGG GTG GAG
Lys Leu Val Glu Glu Gly Arg Trp Glu Pro Val Gly Gly Met Trp Val Glu

TCG GAC TGC AAC GTT CCA TCG ATA GAG TCG CTT GTG AGA CAG TTC TAC TAT
Ser Asp Cys Asn Val Pro Ser Ile Glu Ser Leu Val Arg Gln Phe Tyr Tyr

GGG CAA AAA TTC TTC GAA AGA GAA TTC GGG AAA AAG AGC AAG GTG TGC TGG
Gly Gln Lys Phe Phe Glu Arg Glu Phe Gly Lys Lys Ser Lys Val Cys Trp

CTT CCG GAT GTG TTT GGG TTT TCC TGG GTG CTT CCC CAA ATT CTG AAA GAA
Leu Pro Asp Val Phe Gly Phe Ser Trp Val Leu Pro Gln Ile Leu Lys Glu

GCC GGG ATA AAA TAC TTC GTC ACC ACG AAA CTC AAC TGG AAC GAC ACG AAC

90/121

Ala Gly Ile Lys Tyr Phe Val Thr Thr Lys Leu Asn Trp Asn Asp Thr Asn

GAG TTT CCG TAC GAT CTG TGC CGC TGG AGG GGA ATA GAT GGA TCC GAA GTG

Glu Phe Pro Tyr Asp Leu Cys Arg Trp Arg Gly Ile Asp Gly Ser Glu Val

ATC TAT TTC AGT TTC AAA AAT CCC AAC GAG GGG TAC AAC GGA AAG ATA GAT

Ile Tyr Phe Ser Phe Lys Asn Pro Asn Glu Gly Tyr Asn Gly Lys Ile Asp

CCC GAT ACG GTC TAC AAA ACC TGG AAG AAC TTC AGG CAG AAA GAT CTC ACA

Pro Asp Thr Val Tyr Lys Thr Trp Lys Asn Phe Arg Gln Lys Asp Leu Thr

AAC AGA GTT CTT CTT TCG TTC GGA CAC GGT GAT GGT GGT GGC GGT CCA ACC

Asn Arg Val Leu Leu Ser Phe Gly His Gly Asp Gly Gly Gly Gly Pro Thr

GAA GAG ATG CTG GAA AAT TAC GAG GTT CTG AAG GAT TTC CCT GGA CTA CCG

Glu Glu Met Leu Glu Asn Tyr Glu Val Leu Lys Asp Phe Pro Gly Leu Pro

CAC CTT GAA ATG GGA ACT GTG GAA GAA TTT TTC AAG AAG GTG GAG ATC GAC

His Leu Glu Met Gly Thr Val Glu Glu Phe Phe Lys Lys Val Glu Ile Asp

GAA GAA CTC CCT GTG TGG GAC GGA GAG CTT TAC CTT GAA CTT CAC AGG GGA

Glu Glu Leu Pro Val Trp Asp Gly Glu Leu Tyr Leu Glu Leu His Arg Gly

91/121

ACC TAC ACT TCT CAG TTC AGG ACA AAG AAA CTT CAC AAA GAA GCG GAA GAC
Thr Tyr Thr Ser Gln Phe Arg Thr Lys Lys Leu His Lys Glu Ala Glu Asp

AGT CTT TAT CTT GCA GAG TTG ATC TCG GCT TTC ACG GAT AAA GAT TTT TCG
Ser Leu Tyr Leu Ala Glu Leu Ile Ser Ala Phe Thr Asp Lys Asp Phe Ser

GAC GAA ATA GAC GAA CTC TGG AAG ATT CTG TTG AGA AAC GAA TTT CAC GAT
Asp Glu Ile Asp Glu Leu Trp Lys Ile Leu Leu Arg Asn Glu Phe His Asp

ATT CTA CCT GGA TCT TCT ATA AAG GAA GTC TAT GAA GAT ACA GAA AAA GAG
Ile Leu Pro Gly Ser Ser Ile Lys Glu Val Tyr Glu Asp Thr Glu Lys Glu

CTC AGA CAT GTG ATA GAA AAA TCA AAA GAC ATC GTT ATC GAA TCT CTC AAA
Leu Arg His Val Ile Glu Lys Ser Lys Asp Ile Val Ile Glu Ser Leu Lys

GTT CTT TCC TCT GAG AAC AAA GAT GTT CTA ACC ATT TTG AAC GCT TCA TCG
Val Leu Ser Ser Glu Asn Lys Asp Val Leu Thr Ile Leu Asn Ala Ser Ser

TTT CCA AAG AAG TGT CTT TTC TTC CTC AAC GAA GAT CTC GCG ATT TCC TTT
Phe Pro Lys Lys Cys Leu Phe Phe Leu Asn Glu Asp Leu Ala Ile Ser Phe

GAA GGA GAA GCA CTC TTG AAA CAG AAA ACT CAC GAT GGA AGG TAT GTG TAC
Glu Gly Glu Ala Leu Leu Lys Gln Lys Thr His Asp Gly Arg Tyr Val Tyr

92/121

TTC ATA GAC AGG GAG ATT CCT CCG TTC ACG AAA GTA GAA CTG AAA GTT CGC

Phe Ile Asp Arg Glu Ile Pro Pro Phe Thr Lys Val Glu Leu Lys Val Arg

AAA GCC ACG TCT GAG GAA ACT CCA AGT GAG TTG AGA GAA ACA AAC ATC ATG

Lys Ala Thr Ser Glu Glu Thr Pro Ser Glu Leu Arg Glu Thr Asn Ile Met

GAG AAC GAA TTT CTC AGG GTG CAC GTC AAC GAT GAC GGA ACA ATT CAA ATC

Glu Asn Glu Phe Leu Arg Val His Val Asn Asp Asp Gly Thr Ile Gln Ile

TAC GAC AAA GAA CTG GAC AGG TAC GTT TTC GAA GAG AAG GGA AAC ATC TTG

Tyr Asp Lys Glu Leu Asp Arg Tyr Val Phe Glu Glu Lys Gly Asn Ile Leu

AAA CTT CAT AAA AAC ATC CCT GCT TAC TGG GAC AAC TGG GAT ATC GCA GAA

Lys Leu His Lys Asn Ile Pro Ala Tyr Trp Asp Asn Trp Asp Ile Ala Glu

AAC GTG GAA AAG ACA GGA TAT ACC CTG AGG GCG AAA AAC ATA GAA AAA ATA

Asn Val Glu Lys Thr Gly Tyr Thr Leu Arg Ala Lys Asn Ile Glu Lys Ile

GAG TCT GGC CCT GTT CGA GAA GTG ATC CGT GTT GAA CAT GAA TCA GAA GGA

Glu Ser Gly Pro Val Arg Glu Val Ile Arg Val Glu His Glu Ser Glu Gly

AGC AGG ATC ACG CAG CAT TAC ATC CTT TAC AGA AAG AGT AGA AGG CTC GAT

93/121

Ser Arg Ile Thr Gln His Tyr Ile Leu Tyr Arg Lys Ser Arg Arg Leu Asp

ATA GAA ACG AAG GTA GAC TGG CAC ACA AGG CGT GCG CTT CTC AGA GCC TAC

Ile Glu Thr Lys Val Asp Trp His Thr Arg Arg Ala Leu Leu Arg Ala Tyr

TTC CCA ACA ACT GTT CTG TCG AGA AAG GCT AGG TTC GAT ATC TCC GGT GGT

Phe Pro Thr Thr Val Leu Ser Arg Lys Ala Arg Phe Asp Ile Ser Gly Gly

TTC ATC GAA AGG CCC ACA CAC AGA AAC ACC AGT TTC GAA CAG GCG CGT TTC

Phe Ile Glu Arg Pro Thr His Arg Asn Thr Ser Phe Glu Gln Ala Arg Phe

GAG GTG CCG TTT CAC AGG TGG ATG GAT CTT TCC CAG ACA GAC TTC GGC GTG

Glu Val Pro Phe His Arg Trp Met Asp Leu Ser Gln Thr Asp Phe Gly Val

TCC ATT CTG AAC GAC GGA AAA TAC GGT GGC AGT GTT CAT CAG GGT ATC ATG

Ser Ile Leu Asn Asp Gly Lys Tyr Gly Gly Ser Val His Gln Gly Ile Met

GCG CTT TCA CTG ATA AAA GCG GGT ATT TTC CCC GAT TTT CTC TGT GAC GAA

Ala Leu Ser Leu Ile Lys Ala Gly Ile Phe Pro Asp Phe Leu Cys Asp Glu

GGC GAA CAC ACT TTC ACC TAT TCT GTC TAC GTA CAC CCT GGA GAC AGC TTG

Gly Glu His Thr Phe Thr Tyr Ser Val Tyr Val His Pro Gly Asp Ser Leu

94/121

AGA GAT GTT GTA AAA GGA TCA GAA GAT CTC AAC AGA TCT TTC ATC GTT CAT

Arg Asp Val Val Lys Gly Ser Glu Asp Leu Asn Arg Ser Phe Ile Val His

CGC GGG GTG TTG AAC CTC CCC TCT CCT TTA CTG GAG ATC TCT CCT CAA AAC

Arg Gly Val Leu Asn Leu Pro Ser Pro Leu Leu Glu Ile Ser Pro Gln Asn

TTC CGT CTC ACC TCA CTG AGA AGG GTG AAG GAC AAA ATT GTT TTG AGG CTT

Phe Arg Leu Thr Ser Leu Arg Arg Val Lys Asp Lys Ile Val Leu Arg Leu

GTT GAG ATT TTC GGA ACA TCA GGG AAA CTT TCC ATT AAA CTC CCA TGG CAT

Val Glu Ile Phe Gly Thr Ser Gly Lys Leu Ser Ile Lys Leu Pro Trp His

GGT GAA ATC TAT CAG ACG AAC GTT CTG GAA GAG AAA AAA CAG AAA GTC ACC

Gly Glu Ile Tyr Gln Thr Asn Val Leu Glu Glu Lys Lys Gln Lys Val Thr

TTC CCA GTG GTT TAC CAT CCG TTC AAG ATC TAC ACT TTT GTT GTA GAA GGT

Phe Pro Val Val Tyr His Pro Phe Lys Ile Tyr Thr Phe Val Val Glu Gly

TGA 3011

END

Figure 1T

(SEQ ID NO:39 - nucleotide sequence and SEQ ID NO:40 - amino acid sequence)
Thermotoga maritima MSB8 (Clone # 6GC18) Glycosidase

1

ATG GAA CTG TAC AGG GAT CCT TCG CAA CCC ATC GAA GTG AGA GTG AGA GAT

Met Glu Leu Tyr Arg Asp Pro Ser Gln Pro Ile Glu Val Arg Val Arg Asp

CTT CTT TCC AGA ATG ACG CTG GAA GAG AAA GTG GCC CAG CTT GGG TCT GTC

Leu Leu Ser Arg Met Thr Leu Glu Glu Lys Val Ala Gln Leu Gly Ser Val

TGG GGT TAC GAA CTG ATA GAC GAG AGG GGA AAG TTC AGT AGA GAA AAA GCA

Trp Gly Tyr Glu Leu Ile Asp Glu Arg Gly Lys Phe Ser Arg Glu Lys Ala

AAA GAA CTC CTC AAA AAT GGT ATA GGC CAG ATC ACA AGG CCT GGT GGA TCA

Lys Glu Leu Leu Lys Asn Gly Ile Gly Gln Ile Thr Arg Pro Gly Gly Ser

ACG AAC CTT GAA CCT CAA GAA GCC GCG GAA CTT GTG AAC GAA ATA CAG AGA

Thr Asn Leu Glu Pro Gln Glu Ala Ala Glu Leu Val Asn Glu Ile Gln Arg

TTT CTT GTG GAA GAA ACA CGC CTT GGA ATT CCT GCG ATG ATA CAC GAA GAA

Phe Leu Val Glu Glu Thr Arg Leu Gly Ile Pro Ala Met Ile His Glu Glu

TGT CTC ACC GGT TAC ATG GGA CTT GGA GGA ACC AAC TTC CCT CAG GCG ATA

Cys Leu Thr Gly Tyr Met Gly Leu Gly Gly Thr Asn Phe Pro Gln Ala Ile

96/121

GCA ATG GCG AGT ACA TGG GAT CCA GAT CTC ATA GAA AAA ATG ACC ACC GCC

Ala Met Ala Ser Thr Trp Asp Pro Asp Leu Ile Glu Lys Met Thr Thr Ala

GTC AGA GAG GAT ATG AGA AAG ATA GGG GCA CAT CAG GGT CTC GCA CCT GTT

Val Arg Glu Asp Met Arg Lys Ile Gly Ala His Gln Gly Leu Ala Pro Val

CTG GAT GTC GCA AGA GAT CCA AGG TGG GGG AGA ACA GAA GAG ACG TTC GGA

Leu Asp Val Ala Arg Asp Pro Arg Trp Gly Arg Thr Glu Glu Thr Phe Gly

GAA TCT CCC TAT CTG GTG GCG AGG ATG GGA GTC TCT TAC GTG AAA GGC CTC

Glu Ser Pro Tyr Leu Val Ala Arg Met Gly Val Ser Tyr Val Lys Gly Leu

CAG GGG GAA GAT ATC AAA AAA GGT GTC GTT GCC ACA GTG AAA CAC TTC GCC

Gln Gly Glu Asp Ile Lys Lys Gly Val Val Ala Thr Val Lys His Phe Ala

GGA TAC AGC GCT TCT GAA GGT GGA AAG AAC TGG GCA CCA ACG AAC ATT CCG

Gly Tyr Ser Ala Ser Glu Gly Gly Lys Asn Trp Ala Pro Thr Asn Ile Pro

GAG AGG GAA TTC AAA GAG GTC TTT CTC TTT CCG TTC GAA GCG GCC GTT AAA

Glu Arg Glu Phe Lys Glu Val Phe Leu Phe Pro Phe Glu Ala Ala Val Lys

GAA GCG AAT GTG CTT TCT GTG ATG AAC TCC TAC AGC GAA ATA GAC GGT GTC

Glu Ala Asn Val Leu Ser Val Met Asn Ser Tyr Ser Glu Ile Asp Gly Val

97/121

CCA TGT GCA GCG AAC AGG AAA CTC CTC ACA GAC ATT CTC AGA AAA GAC TGG

Pro Cys Ala Ala Asn Arg Lys Leu Leu Thr Asp Ile Leu Arg Lys Asp Trp

GGA TTC GAA GGA ATC GTC GTT TCT GAC TAT TTT GCT GTG AAA GTT CTG GAA

Gly Phe Glu Gly Ile Val Val Ser Asp Tyr Phe Ala Val Lys Val Leu Glu

GAT TAT CAC AGA ATA GCA AGG GAT AAG TCA GAA GCC GCA AGA CTC GCA CTT

Asp Tyr His Arg Ile Ala Arg Asp Lys Ser Glu Ala Ala Arg Leu Ala Leu

GAA GCG GGG ATA GAT GTT GAA CTT CCG AAG ACA GAA TGT TAT CAA TAT TTG

Glu Ala Gly Ile Asp Val Glu Leu Pro Lys Thr Glu Cys Tyr Gln Tyr Leu

AAA GAC CTT GTT GAA AAA GGC ATC ATC TCC GAA GCT TTG ATC GAC GAG GCA

Lys Asp Leu Val Glu Lys Gly Ile Ile Ser Glu Ala Leu Ile Asp Glu Ala

GTC ACC AGG GTG CTG AGG CTG AAG TTC ATG CTC GGG CTC TTC GAA AAT CCC

Val Thr Arg Val Leu Arg Leu Lys Phe Met Leu Gly Leu Phe Glu Asn Pro

TAC GTT GAG GTG GAA AAA GCA AAG ATA GAA AGT CAC AGA GAC ATC GCA CTC

Tyr Val Glu Val Glu Lys Ala Lys Ile Glu Ser His Arg Asp Ile Ala Leu

GAG ATA GCA AGG AAA TCC ATT ATC CTT CTC AAG AAT GAT GGA ATT CTG CCT

98/121

Glu Ile Ala Arg Lys Ser Ile Ile Leu Leu Lys Asn Asp Gly Ile Leu Pro

CTT CAG AAA AAC AAA AAA GTT GCC CTG ATC GGA CCG AAC GCG GGT GAG GTG

Leu Gln Lys Asn Lys Lys Val Ala Leu Ile Gly Pro Asn Ala Gly Glu Val

AGA AAT CTC CTC GGA GAT TAC ATG TAC CTT GCA CAC ATA AGG GCT CTC CTC

Arg Asn Leu Leu Gly Asp Tyr Met Tyr Leu Ala His Ile Arg Ala Leu Leu

GAC AAC ATA GAC GAC GTC TTT GGA AAT CCT CAG ATC CCG AGA GAA AAC TAC

Asp Asn Ile Asp Asp Val Phe Gly Asn Pro Gln Ile Pro Arg Glu Asn Tyr

GAA AGA CTG AAG AAG AGC ATA GAA GAA CAT ATG AAG AGC ATT CCG AGT GTT

Glu Arg Leu Lys Lys Ser Ile Glu Glu His Met Lys Ser Ile Pro Ser Val

CTC GAT GCC TTC AAA GAA GAA GGG ATC GAA TTC GAA TAT GCA AAA GGC TGT

Leu Asp Ala Phe Lys Glu Glu Gly Ile Glu Phe Glu Tyr Ala Lys Gly Cys

GAA GTG ACA GGG GAA GAC AGA AGC GGT TTC GAA GAG GCG ATA GAA ATT GCA

Glu Val Thr Gly Glu Asp Arg Ser Gly Phe Glu Glu Ala Ile Glu Ile Ala

AAG AAA TCC GAC GTT GCC ATC GTT GTC GTA GGG GAC AAA TCT GGA CTC ACC

Lys Lys Ser Asp Val Ala Ile Val Val Val Gly Asp Lys Ser Gly Leu Thr

99/121

CTT GAC TGC ACA ACC GGT GAG TCC AGA GAC ATG GCA AAC CTC AAG CTT CCA
Leu Asp Cys Thr Thr Gly Glu Ser Arg Asp Met Ala Asn Leu Lys Leu Pro

GGA GTC CAG GAA GAA CTC GTC CTC GAA GTT GCA AAG ACA GGA AAA CCC GTC
Gly Val Gln Glu Glu Leu Val Leu Glu Val Ala Lys Thr Gly Lys Pro Val

GTT CTT GTC CTC ATC ACG GGA AGA CCC TAT TCA CTC AAA AAC GTC GTC GAC
Val Leu Val Leu Ile Thr Gly Arg Pro Tyr Ser Leu Lys Asn Val Val Asp

AAG GTG AAC GCG ATC CTT CAG GTG TGG CTT CCT GGA GAA GCG GGA GGA AGA
Lys Val Asn Ala Ile Leu Gln Val Trp Leu Pro Gly Glu Ala Gly Gly Arg

GCG ATC GTT GAC ATC ATC TAT GGA AAG GTG AAT CCC TCT GGA AAA CTC CCG
Ala Ile Val Asp Ile Ile Tyr Gly Lys Val Asn Pro Ser Gly Lys Leu Pro

ATC AGC TTT CCA AGA AGC GCT GGT CAG ATT CCT GTC TTC CAC TAC GTC AAA
Ile Ser Phe Pro Arg Ser Ala Gly Gln Ile Pro Val Phe His Tyr Val Lys

CCA TCC GGG GGA AGG TCT CAC TGG CAC GGA GAC TAC GTG GAT GAG AGC ACA
Pro Ser Gly Gly Arg Ser His Trp His Gly Asp Tyr Val Asp Glu Ser Thr

AAG CCT CTC TTC CCG TTT GGG CAC GGT TTG TCT TAC ACG AAG TTC GAG TAC
Lys Pro Leu Phe Pro Phe Gly His Gly Leu Ser Tyr Thr Lys Phe Glu Tyr

100/121

AGC AAC CTC AGA ATC GAG CCG AAG GAA GTG CCA CCG GCC GGC GAA GTG GTG

Ser Asn Leu Arg Ile Glu Pro Lys Glu Val Pro Pro Ala Gly Glu Val Val

ATA AAG GTG GAC GTG GAA AAC ATC GGA GAC AGA GAC GGA GAC GAG GTG GTT

Ile Lys Val Asp Val Glu Asn Ile Gly Asp Arg Asp Gly Asp Glu Val Val

CAA CTT TAC ATC GGT CGT GAG TTT GCA AGC GTC ACA AGG CCT GTG AAA GAG

Gln Leu Tyr Ile Gly Arg Glu Phe Ala Ser Val Thr Arg Pro Val Lys Glu

CTG AAG GGC TTC AAG AGG GTT TCT TTG AAG GCG AAA GAG AAG AAG ACT GTT

Leu Lys Gly Phe Lys Arg Val Ser Leu Lys Ala Lys Glu Lys Lys Thr Val

GTG TTC AGG CTT CAC ATG GAC GTG CTC GCC TAC TAC AAC AGA GAC ATG AAA

Val Phe Arg Leu His Met Asp Val Leu Ala Tyr Tyr Asn Arg Asp Met Lys

CTC GTG GTT GAA CCC GGT GAG TTC AAA GTG ATG GTG GGA AGC TCT TCT GAA

Leu Val Val Glu Pro Gly Glu Phe Lys Val Met Val Gly Ser Ser Ser Glu

GAC ATC AGA CTC ACA GGT TCT TTC TCC GTC GTC GGT GAA AAA AGA GAA GTG

Asp Ile Arg Leu Thr Gly Ser Phe Ser Val Val Gly Glu Lys Arg Glu Val

GTG GGA ATG AGG AAA TTC TTC ACG GAA GCC TGC GAG GAG TGA 2336

Val Gly Met Arg Lys Phe Phe Thr Glu Ala Cys Glu Glu END

101/121

Figure 1U

(SEQ ID NO:41 - nucleotide sequence and SEQ ID NO:42 - amino acid sequence)

Thermotoga maritima MSB8 (Clone # 6GP2) Glycosidase

1

ATG GGG ATT GGT GGC GAC GAC TCC TGG AGC CCG TCA GTA TCG GCG GAA TTC

Met Gly Ile Gly Gly Asp Asp Ser Trp Ser Pro Ser Val Ser Ala Glu Phe

CTT TTA TTG ATC GTT GAG CTC TCT TTC GTT CTC TTT GCA AGT GAC GAG TTC

Leu Leu Leu Ile Val Glu Leu Ser Phe Val Leu Phe Ala Ser Asp Glu Phe

GTG AAA GTG GAA AAC GGA AAA TTC GCT CTG AAC GGA AAA GAA TTC AGA TTC

Val Lys Val Glu Asn Gly Lys Phe Ala Leu Asn Gly Lys Glu Phe Arg Phe

ATT GGA AGC AAC AAC TAC TAC ATG CAC TAC AAG AGC AAC GGA ATG ATA GAC

Ile Gly Ser Asn Asn Tyr Tyr Met His Tyr Lys Ser Asn Gly Met Ile Asp

AGT GTT CTG GAG AGT GCC AGA GAC ATG GGT ATA AAG GTC CTC AGA ATC TGG

Ser Val Leu Glu Ser Ala Arg Asp Met Gly Ile Lys Val Leu Arg Ile Trp

GGT TTC CTC GAC GGG GAG AGT TAC TGC AGA GAC AAG AAC ACC TAC ATG CAT

Gly Phe Leu Asp Gly Glu Ser Tyr Cys Arg Asp Lys Asn Thr Tyr Met His

CCT GAG CCC GGT GTT TTC GGG GTG CCA GAA GGA ATA TCG AAC GCC CAG AGC

Pro Glu Pro Gly Val Phe Gly Val Pro Glu Gly Ile Ser Asn Ala Gln Ser

102/121

GGT TTC GAA AGA CTC GAC TAC ACA GTT GCG AAA GCG AAA GAA CTC GGT ATA
Gly Phe Glu Arg Leu Asp Tyr Thr Val Ala Lys Ala Lys Glu Leu Gly Ile

AAA CTT GTC ATT GTT CTT GTG AAC AAC TGG GAC GAC TTC GGT GGA ATG AAC
Lys Leu Val Ile Val Leu Val Asn Asn Trp Asp Asp Phe Gly Gly Met Asn

CAG TAC GTG AGG TGG TTT GGA GGA ACC CAT CAC GAC GAT TTC TAC AGA GAT
Gln Tyr Val Arg Trp Phe Gly Gly Thr His His Asp Asp Phe Tyr Arg Asp

GAG AAG ATC AAA GAA GAG TAC AAA AAG TAC GTC TCC TTT CTC GTA AAC CAT
Glu Lys Ile Lys Glu Glu Tyr Lys Lys Tyr Val Ser Phe Leu Val Asn His

GTC AAT ACC TAC ACG GGA GTT CCT TAC AGG GAA GAG CCC ACC ATC ATG GCC
Val Asn Thr Tyr Thr Gly Val Pro Tyr Arg Glu Glu Pro Thr Ile Met Ala

TGG GAG CTT GCA AAC GAA CCG CGC TGT GAG ACG GAC AAA TCG GGG AAC ACG
Trp Glu Leu Ala Asn Glu Pro Arg Cys Glu Thr Asp Lys Ser Gly Asn Thr

CTC GTT GAG TGG GTG AAG GAG ATG AGC TCC TAC ATA AAG AGT CTG GAT CCC
Leu Val Glu Trp Val Lys Glu Met Ser Ser Tyr Ile Lys Ser Leu Asp Pro

AAC CAC CTC GTG GCT GTG GGG GAC GAA GGA TTC TTC AGC AAC TAC GAA GGA
Asn His Leu Val Ala Val Gly Asp Glu Gly Phe Phe Ser Asn Tyr Glu Gly

103/121

TTC AAA CCT TAC GGT GGA GAA GCC GAG TGG GCC TAC AAC GGC TGG TCC GGT

Phe Lys Pro Tyr Gly Gly Glu Ala Glu Trp Ala Tyr Asn Gly Trp Ser Gly

GTT GAC TGG AAG AAG CTC CTT TCG ATA GAG ACG GTG GAC TTC GGC ACG TTC

Val Asp Trp Lys Lys Leu Leu Ser Ile Glu Thr Val Asp Phe Gly Thr Phe

CAC CTC TAT CCG TCC CAC TGG GGT GTC AGT CCA GAG AAC TAT GCC CAG TGG

His Leu Tyr Pro Ser His Trp Gly Val Ser Pro Glu Asn Tyr Ala Gln Trp

GGA GCG AAG TGG ATA GAA GAC CAC ATA AAG ATC GCA AAA GAG ATC GGA AAA

Gly Ala Lys Trp Ile Glu Asp His Ile Lys Ile Ala Lys Glu Ile Gly Lys

CCC GTT GTT CTG GAA GAA TAT GGA ATT CCA AAG AGT GCG CCA GTT AAC AGA

Pro Val Val Leu Glu Glu Tyr Gly Ile Pro Lys Ser Ala Pro Val Asn Arg

ACG GCC ATC TAC AGA CTC TGG AAC GAT CTG GTC TAC GAT CTC GGT GGA GAT

Thr Ala Ile Tyr Arg Leu Trp Asn Asp Leu Val Tyr Asp Leu Gly Gly Asp

GGA GCG ATG TTC TGG ATG CTC GCG GGA ATC GGG GAA GGT TCG GAC AGA GAC

Gly Ala Met Phe Trp Met Leu Ala Gly Ile Gly Glu Gly Ser Asp Arg Asp

GAG AGA GGG TAC TAT CCG GAC TAC GAC GGT TTC AGA ATA GTG AAC GAC GAC

104/121

Glu Arg Gly Tyr Tyr Pro Asp Tyr Asp Gly Phe Arg Ile Val Asn Asp Asp
AGT CCA GAA GCG GAA CTG ATA AGA GAA TAC GCG AAG CTG TTC AAC ACA GGT
Ser Pro Glu Ala Glu Leu Ile Arg Glu Tyr Ala Lys Leu Phe Asn Thr Gly
GAA GAC ATA AGA GAA GAC ACC TGC TCT TTC ATC CTT CCA AAA GAC GGC ATG
Glu Asp Ile Arg Glu Asp Thr Cys Ser Phe Ile Leu Pro Lys Asp Gly Met
GAG ATC AAA AAG ACC GTG GAA GTG AGG GCT GGT GTT TTC GAC TAC AGC AAC
Glu Ile Lys Lys Thr Val Glu Val Arg Ala Gly Val Phe Asp Tyr Ser Asn
ACG TTT GAA AAG TTG TCT GTC AAA GTC GAA GAT CTG GTT TTT GAA AAT GAG
Thr Phe Glu Lys Leu Ser Val Lys Val Glu Asp Leu Val Phe Glu Asn Glu
ATA GAG CAT CTC GGA TAC GGA ATT TAC GGC TTT GAT CTC GAC ACA ACC CGG
Ile Glu His Leu Gly Tyr Gly Ile Tyr Gly Phe Asp Leu Asp Thr Thr Arg
ATC CCG GAT GGA GAA CAT GAA ATG TTC CTT GAA GGC CAC TTT CAG GGA AAA
Ile Pro Asp Gly Glu His Glu Met Phe Leu Glu Gly His Phe Gln Gly Lys
ACG GTG AAA GAC TCT ATC AAA GCG AAA GTG GTG AAC GAA GCA CGG TAC GTG
Thr Val Lys Asp Ser Ile Lys Ala Lys Val Val Asn Glu Ala Arg Tyr Val

105/121

CTC GCA GAG GAA GTT GAT TTT TCC TCT CCA GAA GAG GTG AAA AAC TGG TGG

Leu Ala Glu Glu Val Asp Phe Ser Ser Pro Glu Glu Val Lys Asn Trp Trp

AAC AGC GGA ACC TGG CAG GCA GAG TTC GGG TCA CCT GAC ATT GAA TGG AAC

Asn Ser Gly Thr Trp Gln Ala Glu Phe Gly Ser Pro Asp Ile Glu Trp Asn

GGT GAG GTG GGA AAT GGA GCA CTG CAG CTG AAC GTG AAA CTG CCC GGA AAG

Gly Glu Val Gly Asn Gly Ala Leu Gln Leu Asn Val Lys Leu Pro Gly Lys

AGC GAC TGG GAA GAA GTG AGA GTA GCA AGG AAG TTC GAA AGA CTC TCA GAA

Ser Asp Trp Glu Glu Val Arg Val Ala Arg Lys Phe Glu Arg Leu Ser Glu

TGT GAG ATC CTC GAG TAC GAC ATC TAC ATT CCA AAC GTC GAG GGA CTC AAG

Cys Glu Ile Leu Glu Tyr Asp Ile Tyr Ile Pro Asn Val Glu Gly Leu Lys

GGA AGG TTG AGG CCG TAC GCG GTT CTG AAC CCC GGC TGG GTG AAG ATA GGC

Gly Arg Leu Arg Pro Tyr Ala Val Leu Asn Pro Gly Trp Val Lys Ile Gly

CTC GAC ATG AAC AAC GCG AAC GTG GAA AGT GCG GAG ATC ATC ACT TTC GGC

Leu Asp Met Asn Asn Ala Asn Val Glu Ser Ala Glu Ile Ile Thr Phe Gly

GGA AAA GAG TAC AGA AGA TTC CAT GTA AGA ATT GAG TTC GAC AGA ACA GCG

Gly Lys Glu Tyr Arg Arg Phe His Val Arg Ile Glu Phe Asp Arg Thr Ala

106/121

GGG GTG AAA GAA CTT CAC ATA GGA GTT GTC GGT GAT CAT CTG AGG TAC GAT

Gly Val Lys Glu Leu His Ile Gly Val Val Gly Asp His Leu Arg Tyr Asp

GGA CCG ATT TTC ATC GAT AAT GTG AGA CTT TAT AAA AGA ACA GGA GGT ATG

Gly Pro Ile Phe Ile Asp Asn Val Arg Leu Tyr Lys Arg Thr Gly Gly Met

TGA 2042

END

107/121

Figure 1V

(SEQ ID NO:43 - nucleotide sequence and SEQ ID NO:44 - amino acid sequence)
Polyangium brachysporum (Clone # 78GA1) Glycosidase

1

ATG TTC CTG CAT CCG AGG GGT CGC ATG ACC CGC CTA GCG CTC GGC TGT GCC

Met Phe Leu His Pro Arg Gly Arg Met Thr Arg Leu Ala Leu Gly Cys Ala

GTG CTG TGT CTG GCC GTC GCA GGC TGC GGT GGT GGT GAT GAC GAC GGC GAC

Val Leu Cys Leu Ala Val Ala Gly Cys Gly Gly Gly Asp Asp Asp Gly Asp

GAC AAC GGC ACC GCC CCC CAG CCC GCA CCT GGT CAA CCC GAG CCC CCG ACT

Asp Asn Gly Thr Ala Pro Gln Pro Ala Pro Gly Gln Pro Glu Pro Pro Thr

GAC ACC GTG CTG AAA GAC TGG CCT CGC ATC AAC AGC AGC ATC ACC GCC GAC

Asp Thr Val Leu Lys Asp Trp Pro Arg Ile Asn Ser Ser Ile Thr Ala Asp

GCA GCG ATC GAA AGC CGC GTC AAC TCA CTC GTC GCG GCG ATG ACG CTG GAA

Ala Ala Ile Glu Ser Arg Val Asn Ser Leu Val Ala Ala Met Thr Leu Glu

GAA AAA GTC GGC CAG ATG ACG CAG GTC GAA ATC CAG GAG GTG ACG CCG GAG

Glu Lys Val Gly Gln Met Thr Gln Val Glu Ile Gln Glu Val Thr Pro Glu

GAG ATC CGG CAG TAC CAC ATC GGC TCC GTG CTC AAC GGC GGT GGT TCG TTC

Glu Ile Arg Gln Tyr His Ile Gly Ser Val Leu Asn Gly Gly Gly Ser Phe

CCG AAG CAG GAC AAG GGC GCG GCG GTG ACC GAC TGG CTG GCG GTG GCC GAC
Pro Lys Gln Asp Lys Gly Ala Ala Val Thr Asp Trp Leu Ala Val Ala Asp

GCC TTG TGG GCC GCG TCG ATG GAT CCC GCC AAG CCG CGG CGC ATC CCG CTC
Ala Leu Trp Ala Ala Ser Met Asp Pro Ala Lys Pro Arg Arg Ile Pro Leu

ATC TGG GGC ACC GAC GCC GTC CAC GGC CAC AAC AAC GTC AAG GGC GCG ACC
Ile Trp Gly Thr Asp Ala Val His Gly His Asn Asn Val Lys Gly Ala Thr

ATC TTC CCG CAC AAC ATC GGC CTG GGC GCC GCG CGC GAC CCC GAC TTG GTC
Ile Phe Pro His Asn Ile Gly Leu Gly Ala Ala Arg Asp Pro Asp Leu Val

GCC CGC ATC GGC GCC GCC ACG GCG CTG GAA GTG GCA CGC ACC GGC ATC GAC
Ala Arg Ile Gly Ala Ala Thr Ala Leu Glu Val Ala Arg Thr Gly Ile Asp

TGG GTG TTC GCG CCA ACG CTG GCG GTC GTG CGC GAC GAC CGC TGG GGC CGC
Trp Val Phe Ala Pro Thr Leu Ala Val Val Arg Asp Asp Arg Trp Gly Arg

AGC TAC GAA GGC TAT TCG GAA GAC CCC GAA ATC GTC GTC TCC TAT GCC GGC
Ser Tyr Glu Gly Tyr Ser Glu Asp Pro Glu Ile Val Val Ser Tyr Ala Gly

AAG ATG GTC GAA GGC CTG CAG GGC CGA TTG GCG CAG GAC GCG AAG GCC AAC
Lys Met Val Glu Gly Leu Gln Gly Arg Leu Ala Gln Asp Ala Lys Ala Asn

109/121

GAG AAG GTG GTG GCC ACC GCC AAG CAT TTC GTC GGC GAC GGC GGC ACC GAC
Glu Lys Val Val Ala Thr Ala Lys His Phe Val Gly Asp Gly Gly Thr Asp

CAG GGC AAG GAC CAG GGG GTC ACC CGG GTC ACC GAG CGC GAC CTG TTG AAC
Gln Gly Lys Asp Gln Gly Val Thr Arg Val Thr Glu Arg Asp Leu Leu Asn

GTC CAT GCG CGC GGC TAC ATC CCC GCG CTC GAG GCG GGC GCG CAA ACC GTG
Val His Ala Arg Gly Tyr Ile Pro Ala Leu Glu Ala Gly Ala Gln Thr Val

ATG GCC TCC TTC AAC AGC TGG CAG GAC CCG TCG CAG GGC GAG GGC GCC AAG
Met Ala Ser Phe Asn Ser Trp Gln Asp Pro Ser Gln Gly Glu Gly Ala Lys

GCC TTC AAG ATG CAT GGC AGC CGC TAC CTG CTC ACC GAG GCC CTC AAG CAG
Ala Phe Lys Met His Gly Ser Arg Tyr Leu Leu Thr Glu Ala Leu Lys Gln

AAG ATG GGC TTC GAC GGT TTC GTG GTG TCC GAC TGG AAC GGC ATC GGC CAG
Lys Met Gly Phe Asp Gly Phe Val Val Ser Asp Trp Asn Gly Ile Gly Gln

GTC ACC ACC GAG AAC AGC AAC GCG ACG CGC AAC TGC AGC AAC AGC GAC TGC
Val Thr Thr Glu Asn Ser Asn Ala Thr Arg Asn Cys Ser Asn Ser Asp Cys

CCC GAG GCC ATC AAC GCT GGC ATC GAC ATG GTG ATG GTG CCG TAC CGG GCC

110/121

Pro Glu Ala Ile Asn Ala Gly Ile Asp Met Val Met Val Pro Tyr Arg Ala

GAC TGG AAG GCC TTC ATC ACC AAC ACA ATT GCA ATT GTC CGC AAA GGC GAG

Asp Trp Lys Ala Phe Ile Thr Asn Thr Ile Ala Ile Val Arg Lys Gly Glu

ATC GCG CAG GAG CGC ATC GAC AAC GCG GTG CGG CGC ATC CTG CGC GTC AAG

Ile Ala Gln Glu Arg Ile Asp Asn Ala Val Arg Arg Ile Leu Arg Val Lys

TTG CGC GCC GGT CTG TTC GAC AAG CCC ACA CCC TCC GCC CGT CTG GCC TCG

Leu Arg Ala Gly Leu Phe Asp Lys Pro Thr Pro Ser Ala Arg Leu Ala Ser

CGC GAG GTC GGC AGC GCC GAA CAC CGG GCG CTC GCG CGT GAA GCG GTG CGC

Arg Glu Val Gly Ser Ala Glu His Arg Ala Leu Ala Arg Glu Ala Val Arg

AAG TCG TTG GTG CTG TTG AAG AAC AAC GGC CGG GTG CTG CCG CTG GCA CGC

Lys Ser Leu Val Leu Leu Lys Asn Asn Gly Arg Val Leu Pro Leu Ala Arg

AAT GCC AAG GTC CTG GTG GCC GGC AAG AGC GCC AAC AGC CTC GAG AAC CAG

Asn Ala Lys Val Leu Val Ala Gly Lys Ser Ala Asn Ser Leu Glu Asn Gln

ACC GGC GGC TGG TCG CTC AGC TGG CAA GGC ACC GGC AAC GCC AAC GCC GAT

Thr Gly Gly Trp Ser Leu Ser Trp Gln Gly Thr Gly Asn Ala Asn Ala Asp

111/121

TTC GGC GGC GGC ACG ACC GTG TGG CAG GCG ATC CAG AAG ATC GCC CCG AAT
Phe Gly Gly Gly Thr Thr Val Trp Gln Ala Ile Gln Lys Ile Ala Pro Asn

GCC GAA CTC GAC ACC AGC GCC GAC GGC GCC AAG GGC AGC GAT GCC TAC GAC
Ala Glu Leu Asp Thr Ser Ala Asp Gly Ala Lys Gly Ser Asp Ala Tyr Asp

GCC GCG ATC GTC GTG ATC GGT GAA ACA CCG TAC GCC GAA GGT GTC GGA GAC
Ala Ala Ile Val Val Ile Gly Glu Thr Pro Tyr Ala Glu Gly Val Gly Asp

ATC GGC CGC AGC AAG ACG CTG GAA CTC ACC AAG CTG CGT CCA GAA GAC CTC
Ile Gly Arg Ser Lys Thr Leu Glu Leu Thr Lys Leu Arg Pro Glu Asp Leu

GCC GTG ATC GAA GGC CTG CGC GCC AAG GGC GTG AAG AAA ATC GTC ACG CTG
Ala Val Ile Glu Gly Leu Arg Ala Lys Gly Val Lys Lys Ile Val Thr Leu

CTG GTC TCC GGC CGC CCG CTC TAC GTC AAC AAG GAG CTG AAC CGC TCG GAC
Leu Val Ser Gly Arg Pro Leu Tyr Val Asn Lys Glu Leu Asn Arg Ser Asp

GCC TTC GTG GCG GCG TGG CTG CCC GGC ACC GAA GGC GAC GGC GTC GCC GAC
Ala Phe Val Ala Ala Trp Leu Pro Gly Thr Glu Gly Asp Gly Val Ala Asp

GTG CTG TTC CGT GCG GCC GAC GGC AGC GTC GCG CAT GGC TTC AGC GGC AAG
Val Leu Phe Arg Ala Ala Asp Gly Ser Val Ala His Gly Phe Ser Gly Lys

112/121

CTG TCG TTC TCG TGG CCG AAG TCG GCC TGC CAG ACG CCG CTC AAC CGT GGC

Leu Ser Phe Ser Trp Pro Lys Ser Ala Cys Gln Thr Pro Leu Asn Arg Gly

GAC GCC ACC TAC GAC CCG CTC TAC GCT TAT GGC TAC GGC CTT CAA TAC GGC

Asp Ala Thr Tyr Asp Pro Leu Tyr Ala Tyr Gly Tyr Gly Leu Gln Tyr Gly

GAG GAG ACC GAT CAG AGC GCG TAC GAC GAA AGC AGT GCC ACG GTC GGC TGC

Glu Glu Thr Asp Gln Ser Ala Tyr Asp Glu Ser Ser Ala Thr Val Gly Cys

GGC ATC CAG GAC GGC GGC GGC ACC ACG GCC GAG CCG CTG GCG GTG TTC GAA

Gly Ile Gln Asp Gly Gly Gly Thr Thr Ala Glu Pro Leu Ala Val Phe Glu

GGC GGA GCC AAC CAG GGC AAC TGG AAG CTG CGC ATC GGC GCC GAG TCG AGC

Gly Gly Ala Asn Gln Gly Asn Trp Lys Leu Arg Ile Gly Ala Glu Ser Ser

TGG AGC AAC GAT GTG ACG CTG GCC AGC AGC GCG GTG ACG TCG ACG CCG TCC

Trp Ser Asn Asp Val Thr Leu Ala Ser Ser Ala Val Thr Ser Thr Pro Ser

AAC GAA CTG CAG GCC GTG CCG GTG GAC GAC AAG GCC GGG CCG CAA TGG GCG

Asn Glu Leu Gln Ala Val Pro Val Asp Asp Lys Ala Gly Arg Gln Trp Ala

GCG GTG AAG GCG ACC TGG AAC GAC AAG CCC GGC CAG CTC TAC ATG CAA AGC

113/121

Ala Val Lys Ala Thr Trp Asn Asp Lys Pro Gly Gln Leu Tyr Met Gln Ser

GCC AAC CCC GGC GAC CTG GTG GAC CTG ATG GCC TAT CAG AAC TCC GGT GGC

Ala Asn Pro Gly Asp Leu Val Asp Leu Met Ala Tyr Gln Asn Ser Gly Gly

GCG CTG GTG TTC GAC CTG CGT GTC GTC AGT GCG CCG ACC GAC CCG GTC AAG

Ala Leu Val Phe Asp Leu Arg Val Val Ser Ala Pro Thr Asp Pro Val Lys

CTG CGC GTC GAT TGC GGC TGG CCC TGT CTG GGC GAG ATC GAC GTC ACC AGC

Leu Arg Val Asp Cys Gly Trp Pro Cys Leu Gly Glu Ile Asp Val Thr Ser

GCC GTC AAG GCC CAG CCG GTC AAC GCC TGG AAG GAA GTG GCG GTG TCG CTG

Ala Val Lys Ala Gln Pro Val Asn Ala Trp Lys Glu Val Ala Val Ser Leu

CAG TGT TTC GCC GAC GCC GGC ACC GAC CTG GCC ATC GTC AAC ACG CCC TTC

Gln Cys Phe Ala Asp Ala Gly Thr Asp Leu Ala Ile Val Asn Thr Pro Phe

CTG ATG TAC ACG TCT GGC CGC TTC GAA GCT GCC GTC GCG AAC ATC CGT TGG

Leu Met Tyr Thr Ser Gly Arg Phe Glu Ala Ala Val Ala Asn Ile Arg Trp

GAG CCC AAG CGC ACG CCC AAC GTG GGG TGC AAC GGC GCA CCG ATC GCC GCC

Glu Pro Lys Arg Thr Pro Asn Val Gly Cys Asn Gly Ala Pro Ile Ala Ala

GCG CCT TGA 2711
Ala Pro END

Figure 1W

(SEQ ID NO:45 - nucleotide sequence and SEQ ID NO:46 - amino acid sequence)
Pyrococcus furiosus (Clone # 7EG1) Glycosidase

1

ATG AGC AAG AAA AAG TTC GTC ATC GTA TCT ATC TTA ACA ATC CTT TTA GTA

Met Ser Lys Lys Lys Phe Val Ile Val Ser Ile Leu Thr Ile Leu Leu Val

CAG GCA ATA TAT TTT GTA GAA AAG TAT CAT ACC TCT GAG GAC AAG TCA ACT

Gln Ala Ile Tyr Phe Val Glu Lys Tyr His Thr Ser Glu Asp Lys Ser Thr

TCA AAT ACC TCA TCT ACA CCA CCC CAA ACA ACA CTT TCC ACT ACC AAG GTT

Ser Asn Thr Ser Ser Thr Pro Pro Gln Thr Thr Leu Ser Thr Thr Lys Val

CTC AAG ATT AGA TAC CCT GAT GAC GGT GAG TGG CCA GGA GCT CCT ATT GAT

Leu Lys Ile Arg Tyr Pro Asp Asp Gly Glu Trp Pro Gly Ala Pro Ile Asp

AAG GAT GGT GAT GGG AAC CCA GAA TTC TAC ATT GAA ATA AAC CTA TGG AAC

Lys Asp Gly Asp Gly Asn Pro Glu Phe Tyr Ile Glu Ile Asn Leu Trp Asn

ATT CTT AAT GCT ACT GGA TTT GCT GAG ATG ACG TAC AAT TTA ACC AGC GGC

Ile Leu Asn Ala Thr Gly Phe Ala Glu Met Thr Tyr Asn Leu Thr Ser Gly

GTC CTT CAC TAC GTC CAA CAA CTT GAC AAC ATT GTC TTG AGG GAT AGA AGT

Val Leu His Tyr Val Gln Gln Leu Asp Asn Ile Val Leu Arg Asp Arg Ser

116/121

AAT TGG GTG CAT GGA TAC CCC GAA ATA TTC TAT GGA AAC AAG CCA TGG AAT
Asn Trp Val His Gly Tyr Pro Glu Ile Phe Tyr Gly Asn Lys Pro Trp Asn

GCA AAC TAC GCA ACT GAT GGC CCA ATA CCA TTA CCC AGT AAA GTT TCA AAC
Ala Asn Tyr Ala Thr Asp Gly Pro Ile Pro Leu Pro Ser Lys Val Ser Asn

CTA ACA GAC TTC TAT CTA ACA ATC TCC TAT AAA CTT GAG CCC AAG AAC GGC
Leu Thr Asp Phe Tyr Leu Thr Ile Ser Tyr Lys Leu Glu Pro Lys Asn Gly

CTG CCA ATT AAC TTC GCA ATA GAA TCC TGG TTA ACG AGA GAA GCT TGG AGA
Leu Pro Ile Asn Phe Ala Ile Glu Ser Trp Leu Thr Arg Glu Ala Trp Arg

ACA ACA GGA ATT AAC AGC GAT GAG CAA GAA GTA ATG ATA TGG ATT TAC TAT
Thr Thr Gly Ile Asn Ser Asp Glu Gln Glu Val Met Ile Trp Ile Tyr Tyr

GAC GGA TTA CAA CCG GCT GGC TCC AAA GTT AAG GAG ATT GTA GTC CCA ATA
Asp Gly Leu Gln Pro Ala Gly Ser Lys Val Lys Glu Ile Val Val Pro Ile

ATA GTT AAC GGA ACA CCA GTA AAT GCT ACA TTT GAA GTA TGG AAG GCA AAC
Ile Val Asn Gly Thr Pro Val Asn Ala Thr Phe Glu Val Trp Lys Ala Asn

ATT GGT TGG GAG TAT GTT GCA TTT AGA ATA AAG ACC CCA ATC AAA GAG GGA
Ile Gly Trp Glu Tyr Val Ala Phe Arg Ile Lys Thr Pro Ile Lys Glu Gly

117/121

ACA GTG ACA ATT CCA TAC GGA GCA TTT ATA AGT GTT GCA GCC AAC ATT TCA
Thr Val Thr Ile Pro Tyr Gly Ala Phe Ile Ser Val Ala Ala Asn Ile Ser

AGC TTA CCA AAT TAC ACA GAA CTT TAC TTA GAG GAC GTG GAG ATT GGA ACT
Ser Leu Pro Asn Tyr Thr Glu Leu Tyr Leu Glu Asp Val Glu Ile Gly Thr

GAG TTT GGA ACG CCA AGC ACT ACC TCC GCC CAC CTA GAG TGG TGG ATC ACA
Glu Phe Gly Thr Pro Ser Thr Thr Ser Ala His Leu Glu Trp Trp Ile Thr

AAC ATA ACA CTA ACT CCT CTA GAT AGA CCT CTT ATT TCC TAA 960
Asn Ile Thr Leu Thr Pro Leu Asp Arg Pro Leu Ile Ser End

Figure 1X

(SEQ ID NO:47 - nucleotide sequence and SEQ ID NO:48 - amino acid sequence)
Vibrio Harveyi (Clone # 91GP2) Glycosidase

1

ATG AGA GGT AAC ACG ATG AAG CAA AAA GCG CTA TAT CGA GCA GTA GCA ATG

Met Arg Gly Asn Thr Met Lys Gln Lys Ala Leu Tyr Arg Ala Val Ala Met

GGT TTG AGT GGT CTT GCG AAC GTC GCA TCC GCT AAT GAG ATG GTA AAT CCT

Gly Leu Ser Gly Leu Ala Asn Val Ala Ser Ala Asn Glu Met Val Asn Pro

GAT GGT GGT GTC GTA GTG GGT TAC TGG CAT AAC TGG TGC GAT GGC GCT GGT

Asp Gly Gly Val Val Val Gly Tyr Trp His Asn Trp Cys Asp Gly Ala Gly

TAC AAG GGA GGT AAT GCA CCG TGT GTA ACA TTG GAT GAA GTT GAT CCT ATG

Tyr Lys Gly Gly Asn Ala Pro Cys Val Thr Leu Asp Glu Val Asp Pro Met

TAC AAT GTG GTT AAC GTC TCC TTT ATG AAG GTA TTC AAT ACC AGT GAA GGT

Tyr Asn Val Val Asn Val Ser Phe Met Lys Val Phe Asn Thr Ser Glu Gly

CGT ATT CCA ACC TTT AAG CTC GAT CCA AAT ATC GGC CTT TCA GAA CAA CAA

Arg Ile Pro Thr Phe Lys Leu Asp Pro Asn Ile Gly Leu Ser Glu Gln Gln

TTT TTT GAC CAA ATT GAA GCT CTA AAC CAA CAA GGA CGT GCC GTT CTC ATC

Phe Phe Asp Gln Ile Glu Ala Leu Asn Gln Gln Gly Arg Ala Val Leu Ile

119/121

GCT CTT GGT GGC GCA GAT GCT CAC GTT GAA CTT AGA ACT GGT GAC GAA CAA
Ala Leu Gly Gly Ala Asp Ala His Val Glu Leu Arg Thr Gly Asp Glu Gln

GCG TTC GCA CAA GAG ATT ATT CGT TTA ACG GAT AAG TTC GGT TTT GAT GGT
Ala Phe Ala Gln Glu Ile Ile Arg Leu Thr Asp Lys Phe Gly Phe Asp Gly

CTA GAT ATC GAT TTA GAG CAG TCA GCA GTA ACG GCA GAG AAC AAC CAA ACC
Leu Asp Ile Asp Leu Glu Gln Ser Ala Val Thr Ala Glu Asn Asn Gln Thr

GTA ATT CCA GCT GCA CTT CGC CTT GTA AAA GAG CAT TAT CAA CAA CAA GGT
Val Ile Pro Ala Ala Leu Arg Leu Val Lys Glu His Tyr Gln Gln Gln Gly

AAG AAC TTC CTA ATT ACG ATG GCG CCT GAA TTC CCT TAT CTA ACA GAA GGT
Lys Asn Phe Leu Ile Thr Met Ala Pro Glu Phe Pro Tyr Leu Thr Glu Gly

GGC AAG TAT GTT CCT TAC ATT ACT GGT TTA GAA GGG TAC TAC GAT TGG ATC
Gly Lys Tyr Val Pro Tyr Ile Thr Gly Leu Glu Gly Tyr Tyr Asp Trp Ile

AAC CCT CAG TTT TAC AAT CAA GGT GGT GAC GGT ATT TGG GTT GAT GGC GTG
Asn Pro Gln Phe Tyr Asn Gln Gly Gly Asp Gly Ile Trp Val Asp Gly Val

GGT TGG ATA GCG CAA AAC AAT GAT GAG TTA AAA CAA GAG TTT ATT TAC TAC
Gly Trp Ile Ala Gln Asn Asn Asp Glu Leu Lys Gln Glu Phe Ile Tyr Tyr

120/121

ATT TCG GAC GCT CTA TCG AAC GGT ACA CGC GGT TTC CAC AAA ATC CCG CAT
Ile Ser Asp Ala Leu Ser Asn Gly Thr Arg Gly Phe His Lys Ile Pro His

GAC AAA CTG GTG TTT GGT ATC CCA TCT AAC ATT GAT GCT GCT GCA ACG GGC
Asp Lys Leu Val Phe Gly Ile Pro Ser Asn Ile Asp Ala Ala Ala Thr Gly

TTT GTT CAA AAC CCT CAA GAC CTT TAC GAC GCG TTT GAT CAA CTT AAA GCG
Phe Val Gln Asn Pro Gln Asp Leu Tyr Asp Ala Phe Asp Gln Leu Lys Ala

CAA GGG CAG GCA CTT CGT GGC GTA ATG ACA TGG TCG GTG AAC TGG GAT ATG
Gln Gly Gln Ala Leu Arg Gly Val Met Thr Trp Ser Val Asn Trp Asp Met

GGC ACC GAT AAA AAT GGC CAA GCG TAC GGT GAA AAA TTC GTG AAG GAT TAC
Gly Thr Asp Lys Asn Gly Gln Ala Tyr Gly Glu Lys Phe Val Lys Asp Tyr

GGT CCG TTT ATC CAC GGG CAG ACT CCA CCA CCA AGT GAA GGT GAA CCA GTT
Gly Pro Phe Ile His Gly Gln Thr Pro Pro Pro Ser Glu Gly Glu Pro Val

TTT AGT GGC CTC AAC GAT GTT CGT GTG CAT CAC GGT AGT TCA TTT GAC CCG
Phe Ser Gly Leu Asn Asp Val Arg Val His His Gly Ser Ser Phe Asp Pro

TAT GCA GGT GTT ACT GCG TCT GAT AAA GAA GAT GGA GAC CTA ACC AAC AGC

121/121

Tyr Ala Gly Val Thr Ala Ser Asp Lys Glu Asp Gly Asp Leu Thr Asn Ser

ATC ACT GTC GAA GGT TCA GTT GAT GTG AAC ACG GTA GGC ACA TAT GTT TTG

Ile Thr Val Glu Gly Ser Val Asp Val Asn Thr Val Gly Thr Tyr Val Leu

GTT TAC AGT GTA AAA GAC AGC GAC AAC AAT GAA ACC AAG CAA AGT AGA ACG

Val Tyr Ser Val Lys Asp Ser Asp Asn Asn Glu Thr Lys Gln Ser Arg Thr

GTT GTT GTT TAC AGC CTA GTG CCT GAG TTT GAA GGT GTC GCA GAT ACG ACC

Val Val Val Tyr Ser Leu Val Pro Glu Phe Glu Gly Val Ala Asp Thr Thr

ATC CAG CTT GGT GAC GCT TTT GAC CCA ATG GCA GGC GTA AAA GCG ACG GAT

Ile Gln Leu Gly Asp Ala Phe Asp Pro Met Ala Gly Val Lys Ala Thr Asp

GCA GAA GAC GGT GAT TTG ACT GAT CGG TAT CTA CGC CGC CTA AGG TCA CTT

Ala Glu Asp Gly Asp Leu Thr Asp Arg Tyr Leu Arg Arg Leu Arg Ser Leu

CTG CGG TGC GAT AGC CTT CTG TGC CAT TTG GTG CAA CCG CCC AGT TTT CCA

Leu Arg Cys Asp Ser Leu Leu Cys His Leu Val Gln Pro Pro Ser Phe Pro

GAC GCT CAA CGA TGG TTG CCA TCT CTT TCT GGT TGA 1514

Asp Ala Gln Arg Trp Leu Pro Ser Leu Ser Gly END